LLOYD'S REGISTER STAFF ASSOCIATION

SESSION
1958 - 59

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Lloyd's Register
Staff Association

Session 1958-59
Paper No. 1

SOME RECENT DEVELOPMENTS IN SWEDISH SHIPBUILDING

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Some Recent Developments in Swedish Shipbuilding

By J. R. Sarginson

When considering the shipbuilding industry in Sweden, there are certain factors that must be borne in mind which are peculiar to this country. At the present time the classification of new construction is shared largely and about equally by two Societies, one of which is Lloyd's Register. The percentage of tonnage classed with the remaining Societies forms only a small percentage of the total and it is quite natural that the two with the largest portion of tonnage under construction have the greatest influence on the structural design of merchant ships in this country.

It is only to be expected that when the shipbuilders discuss technical matters with the two Societies, they receive opinions and ideas that may vary widely, and this leads to a certain independence of action that may not be present to such an extent in other countries. Every amendment made to a new design, for example, has to be justified and it must be mentioned here that a shipyard of any standing has a large and highly skilled technical staff, both indoor and outdoor. In fact it may be stated that the technical staff are the most important and most highly paid in the Swedish yards.

It should not be thought, however, that ship classification is dependent solely on technical considerations. The commercial viewpoint and national inclinations also have a great bearing upon the choice of class. A large proportion of the ships built and building in Sweden are for export, Norway being the best foreign customer.

The majority of the big Swedish shipowning companies have their own technical departments that deal with new designs, new construction and the upkeep of their existing fleets. A close liaison is generally maintained between the ship management staff and the technical staff, so that the utmost is made of the experience gained from ships in service when designing new tonnage. It is also quite common for the Captain and Chief Engineer to be with their new ship from the laying of the keel, full advantage being taken of their ideas and experience.

Most of the ships built in Sweden for Swedish owners and many of those for Norwegian owners return, for their various surveys, to the yard in which they were constructed, opportunity thus being afforded for the yards to gain experience that may be incorporated in new designs. The classification societies also benefit, as care is taken by the plans department and outdoor surveyors when dealing with new construction, to avoid or rectify any faults that have been found in existing ships.

Here it may be added that, especially so far as plan approval work in Sweden is concerned, it is not only the classification society's function to check, amend and perhaps sometimes reject arrangements submitted by the builders. Surveyors are expected to act in an advisory capacity and suggest alternative designs if those proposed are considered unsuitable and also to be of general service to the shipbuilding and shipowning community.

The map of Sweden (Fig. 1) shows the disposition of the shipyards, together with the types of ships built and yard capacities. It will be noted that the largest yards are on the west coast, where the traditional shipbuilding centres are established. Table 1 gives the annual production figures for various yards throughout the world during recent years in numerical order of tons gross delivered, from which it will be seen that the Swedish shipyards are well to the fore.

One firm launched 13 ships totalling 163,045 tons gross from three berths and completed 14 ships having a total of 240,000 tons deadweight during 1957. This high rate of production can be accounted for partly by the amount of prefabrication that is done, so that the length of time on the berth is not a true indication of the actual number of man-hours used for the construction. The practice of sub-contracting portions of the hull to smaller firms is becoming increasingly popular, and it is not uncommon to have double bottom sections, for example, built at a firm of constructional engineers somewhere in the country or at a small yard along the coast which might otherwise have closed down for lack of work. Unfortunately this practice has not always proved successful, for if there are any mistakes in the plans supplied to the contractors or the plans are wrongly interpreted, it is unlikely the errors will be detected until the member is placed in position in the ship. On the contrary if the work is carried out at the yard, the more experienced staff will no doubt see that something is wrong and rectify matters immediately.

As regards arrangements for increasing output, most of the bigger yards are going ahead with plans for increasing the size and number of ships that can be constructed.

It will be noted that none of the Swedish shipyards specialise in passenger liner construction, only one such ship having been built here during recent years. Several yards have built cross-channel passenger, rail and car ferries, but these

are the exception rather than the rule during present times, most of this type of work for Scandinavian owners being carried out in neighbouring Denmark.

In general, emphasis in production is laid on oil tankers, ore and bulk carriers and dry cargo ships. The yards specialising in tanker construction have their own "standard" series of tankers, and very often these comprise three or four standard designs, e.g., 530 ft. (18,000 tons deadweight), 570 ft. (22,000 tons deadweight), 630 ft. (33,000 tons deadweight), 670 ft. (40,000 tons deadweight).

It is much cheaper for an owner to order a standard type than one with different dimensions and most yards aim to have the scantlings and arrangements approved by at least Lloyd's Register and Norske Veritas. One firm is known to have had plans for the same design approved by Lloyd's Register, Norske Veritas, American Bureau of Shipping and Bureau Veritas to suit the demands of their various clients. Very often these standard designs are altered to suit experience gained from earlier ships, and the internal arrangements in a modern tanker are generally quite different from the original design of the series. The same principle applies to a lesser degree to ore carriers, bulk carriers and dry cargo ships.

DRY CARGO SHIPS

Recent Developments

As is well known, the larger Swedish cargo liners built since the war in the range 400 ft. to 500 ft. have invariably been high powered, with comparatively long engine rooms, fine lines with great sheer forward and sometimes long cargo-carrying forecastles. To complicate the longitudinal strength problem, it has often been the practice to fit a refrigerated hold immediately forward of the engine room. This in itself is bad enough, but if the ship is making a voyage without refrigerated cargoes, and it has been found impossible, as is often the case, to obtain ordinary cargoes that can be stowed in this space, it becomes analogous to sailing with an empty midship deep tank.

In more recent designs the position has been improved. The high power and fine lines still persist, but the machinery space has been moved farther aft and in some instances right aft. The latter case produces its own conflicting problems of hogging and trim in the ballast condition which are rather readily overcome. Longitudinal framing at bottom and deck has increased the longitudinal strength, over and above the increases incorporated in the revised rules. The tendency is to move the refrigerated spaces forward, having an ordinary cargo hold between them and the engine room.

The replacement of transverse framing at bottom and deck by longitudinal framing has led to the introduction of a variety of designs. At one shipyard, the double bottom structure takes the form of plate longitudinals supported on every third frame by plate floors (*see* Fig. 6), which are 5 per cent in excess of the rule transverse floor thickness instead of the 10 per cent required with ordinary longitudinals. Figs. 5(a), (b) and (c) show three different arrangements that have been approved for the double bottom in the motor room. In addition to longitudinal framing at the upper deck, some ships have been built with side longitudinals in the 'tween decks and in several cases the second deck has also been longitudinally framed.

As is understood to be the practice elsewhere, the trend in Sweden is for cargo ships to have draughts corresponding to the minimum freeboard as a closed shelter deck ship or at least in excess of those for an open shelter decker—the so-called "intermediate draught" cases. This gives a better ship from the longitudinal strength viewpoint and has also led to several ingenious designs for satisfying the tonnage regulations regarding the closing appliances to be fitted to openings in decks and bulkheads. Owners are not presented with any great difficulties when it is decided to change from one draught to another, as both marks are scrieved into the ship's side, and it is only necessary to obliterate one mark and paint in the other. One yard has patented a shelter deck tonnage opening that can be used whether the ship is open or closed, and this has been approved by the National Authorities. It consists of a steel cover plate and swing bolts that are not permanently attached to the hatch side coaming (*see* Fig. 2(a)). The angle to which the swing bolts are attached is in four parts, and they can be drawn up tight against the coaming by screwing up the bolts connecting the various parts. With regard to tonnage openings in the 'tween deck bulkheads, these can readily be converted from watertight to class II closing appliances or *vice versa* by removing the rubber packing from the bulkhead and reversing the small bearing pieces in way of the toggles (*see* Fig. 2(b)). The revised Swedish Tonnage Regulations, which came into force 1st January, 1955, do not require a 5 in. scupper with S.D.N.R.V. to the tonnage well of open shelter deckers, and it is common practice to drain this space to the tunnel recess or bilge with a S.D.V. geared from the shelter deck.

It is common practice now among Swedish owners to have all accommodation in one unit, amidships with machinery amidships and aft with machinery aft. This has obvious advantages, and its effect, from the structural point of view, on the various types of ship considered will be discussed later in the paper.

Decks below the weather deck in cargo ships of all sizes are generally fitted with flush hatch covers, while weather deck hatches are invariably closed by steel covers. The general tendency seems to be to make cargo hatchway openings of greater size than previously, as this simplifies the unloading of the various parcels of cargo at different ports of call. While dealing with cargo handling, mention should be made of the bipod self-staying mast which has been designed and

patented by a Swedish naval architect and is proving to be very useful in the merchant navies of the world.

The fact that the Swedish Merchant Navy is suffering from a severe shortage of deck and engineer officers, has led several of the larger shipowning companies to introduce "school ships" into their fleets. In some cases these are existing ships converted and in others new ships have been specially fitted out for this purpose. The officer cadets receive their practical and theoretical training simultaneously at sea, and are thus able to sit for their tickets at an earlier age than otherwise. It is hoped by this scheme to get more young men interested in a seafaring life, and to make it more attractive for them.

Some Recent Designs

A series of six twin screw cargo ships of unusual and interesting design have recently been ordered, and at the time of writing two of these ships are in service. They are for the Sweden – South America service in which it is necessary to have large refrigerated cargo capacity as well as space for general cargo. In these ships provision is made for the simultaneous loading of both types of cargo through separate hatches. In connection with the details of these ships given in Fig. 8, the following points should be noted:—

1. In way of Nos. 3 and 4 holds this ship is a single deck type, so far as longitudinal strength is concerned. The second deck in this region consists of stringers and ties covered with wood sheathing.
2. The 'tween deck longitudinal bulkheads abreast the centre line cargo hatches and motor casing are continuous from the fore end of No. 3 hold to the after end of No. 5 hold, with continuation girders at ends.
3. The above mentioned bulkheads form longitudinal girders between the transverse W.T. bulkheads, supporting the various decks in the region covered.
4. The longitudinal girders abreast the side hatches in Nos. 3 and 4 holds are supported by the deck transverses (and cantilevers in way of hatchway openings) and are therefore fully effective longitudinal strength members.

Mention has been made previously of the tendency to move the engine room well aft of amidships, and details of several cases that have been examined for ballast condition stresses in the Gothenburg office during recent years are given in Fig. 9 and Table 2. In order to obtain a comparison between the still water stresses in the various cases, a constant draught to depth ratio of ·70 has been assumed and a load line section modulus at this draught has been used. The stresses given are thus no indication of those expected to be experienced in service, as the actual section modulus of the ship may vary considerably from that given in the table. For example, the deck area in ship No. 4 was increased in order to reduce the calculated still water stresses in the ballast condition.

Swedish law regarding the manning of cargo ships has been the reason for the evolution of a new type of small cargo ship during recent years. A ship of this type, commonly known as a "paragraph boat", is just under 500 tons gross, which is the limit the law permits before the working hours on board are restricted, thus requiring a larger crew. Most of the more recent paragraph boats are open shelter deckers about 200 ft. in length with large depth of double bottom, small depth to freeboard deck and comparatively large 'tween deck height. Fig. 3 shows a midship section for a typical ship of this type. To reduce tonnage it is the practice to increase the depth of alternate hold frames, and very often the main deck is supported by cantilevers in way of the increased frames. Care has to be taken to ensure that the frames of increased depth are efficiently supported or otherwise stiffened against tripping, for the web thickness that may be considered necessary in such small ships may not be sufficient to do so in practice.

The machinery in a paragraph boat is fitted aft, but it is not expected that any structural trouble will be forthcoming in this type of ship due to hogging in the ballast condition, as they have a comparatively small L/D ratio, are generally longitudinally framed with riveted stringer angles and the deep double bottom tanks, if filled with water ballast in the midship region, tend to reduce the hogging stresses. It has been found that the maximum still water hogging stress in ballast is about 4 tons per sq. in. for a ship of this type.

EXPERIENCE GAINED FROM SHIPS IN SERVICE

The older type of transversely framed all welded cargo ships are still causing trouble in certain instances, mainly in the type previously mentioned with high power, fine lines and long forecastles. This takes the form of fractures of the end connections of the bottom longitudinal angle stiffeners to the floors and also buckling of the floor plates and bottom shell in way of the ends of main engine girders, where these have ended too abruptly, not being tapered off gradually into the shell. It would appear, also, that where solid floors are placed on every third or fourth frame, the bottom shell has been working as a panel between these frames.

The number of Swedish cargo ships of all sizes having buckled bottom shell forward, in way of the pounding area, is remarkable. In the case of the small paragraph boats with machinery aft, it is certainly due to the impossibility of getting the head down in the ballast condition, the fore peak tank generally being rather small in this type of ship. In the larger ship with machinery amidships, it is probably due to the force with which they are driven through the seas when light.

Fractures still occur in older ships at the upper deck hatch corners and especially those immediately forward of the midship houses, even

although they may have been reinforced. These are no doubt due to bad design in this region and to the quality of steel fitted. The latter two points should be considered in the light of present-day knowledge. In new designs it has been endeavoured, wherever possible, to have ventilator and similar openings in way of the house front, placed within the line of hatchway openings in order to reduce the stress concentration in this region. It is not always convenient to have ventilators in this position, especially if sliding steel hatch covers are to be stowed there, or the width of passageway is restricted.

In ships of the raised quarter deck type, trouble has been experienced at the break of the raised quarter deck, both in the side shell, especially if there are scuppers in this region, and in way of the hatch side girders where these form a continuous member from upper deck to raised quarter deck. In the latter case it was decided in one instance to reduce the size of the fore peak tank and this, together with the reinforcements, appears to have cured the trouble, for the ship has recently been through special survey without any serious faults being found.

The question of whether or not a midship deep tank should be fitted in small ships having machinery aft, to reduce hogging stresses in the ballast condition, can be discussed, and varies from case to case. Owners are naturally averse to fitting a midship deep tank which can only be used for ballast in a small cargo ship, and it has not been found necessary for such a tank to be fitted in ships less than 300 ft. in length.

Several cases have occured recently in which the bulwark plating has fractured, even although this is free from the sheerstrake, and in the larger ships it is the present practice to fit expansion joints at two points within the midship half length, preferably at the ends of the midship houses, as well as at the normal position of poop and forecastle ends. Bulwark supports of stiffened plate frequently fracture where the plate is cut away to clear the lower bulwark flange, and in an attempt to avoid this it has been the practice to stiffen them in this region.

Most of the larger Swedish cargo liners have a deckhouse amidships with the superimposed houses extending out to the ship's side. If the house front extends to the side in the form of a side screen at the upper deck, this is riveted to the deck in new construction and in existing ships it has been freed from the deck, if previously welded, and a riveted connection made. This does not seem to have solved the problem of the weakness in this region, for it is quite common to find the side screen fractured through the rivets at the ship's side. Furthermore, if the superimposed houses are supported by angle bars welded to the upper deck or bulwark top bar, these generally fracture after a short period in service. The situation is not improved when, as mentioned earlier in the paper, all accommodation is fitted amidships, for this only increases the loads to be taken by the various supporting members. It is therefore suggested that the load from the houses over should not be transmitted to the ship's side, but should instead be carried by 'tween deck webs and cantilevers to the deckhouse side (*see* Fig. 7).

In a previous paper to the Staff Association* details were given of different types of beam knee used in Swedish shipbuilding, and it might be well to state here that those of the type indicated in Fig. 14(c) have proved far from successful and this type of construction is no longer employed. The majority of beam knees in Nos. 1 and 2 holds when of this construction, have fractured as shown in Fig. 4(b) and have required to be reinforced in the manner indicated. The trouble has not been so marked in No. 3 hold and aft. It should also be pointed out that where this type of bracket has been used in other structural parts, for example, for brackets of wing tank top beam knees to tunnel side stiffeners, no fractures have occurred.

Hatch end beam knees at the fore end of No. 1 hatch, second deck, are invariably fractured in the larger ships, a typical example being shown in Fig. 4(a). Swedish ships are very fine in this region, thus giving a narrow deck width, especially where it is desired to maintain a constant width of hatchway opening for fitting sliding steel covers. It is questionable whether a deep beam in this region serves any useful purpose, unless the pillars from above are not supported by a centre line pillar below the main deck, and it is considered that the hatch side girder can be more efficiently supported by two or three cantilevers to the main frames at the fore end of the hatch.

Another recurring trouble is that the scalloped connection of the centre line wash plate in the after peak to the bulkhead and deck is very often fractured. To a lesser degree the same thing has happened in the fore peak, and continuous welds are now asked for in these connections.

OIL TANKERS

Evolution of the Present Structural Design

The design of the modern Swedish tanker, outside the so-called "supertanker" range, has been evolved after a careful study of service experience of existing tankers. As stated previously it is the practice to build series of tankers in most yards and similar failures in the different tankers of a series give clear indications of where modifications are required in future ships. It is interesting to trace the history of tanker construction by one firm from the immediate post-war years to the present time.

This firm started two series, one with dimensions 490 ft. × 65 ft. × 37 ft. and the other 526 ft. × 69 ft. 9 in. × 39 ft. 3 in., the first ships in both series being delivered in 1947. Both original designs were rather similar and quite naturally the same trouble has been experienced in both types. After a time the 490 ft. series was discontinued (nine tankers were built to the

* Notes on Welding in Swedish Shipbuilding. H. J. Adams 1947-8.

Society's class), but the 526 ft. (18,000 tons d.w.) has been developed over the years and it is proposed to trace the history of this design.

The first eight ships of the 18 built to the Society's class were to old Rule scantlings and arrangements. Transverse bulkheads were horizontally corrugated and supported in the first two tankers, by one centre line web and partial intermediate "buttresses" at top and bottom in centre and wing tanks. The longitudinal bulkheads were continuous and in the first ship an ordinary web frame was fitted in the wing tanks in way of alternate centre tank bulkheads. Figs. 10(a) and 10(b) illustrate the main features of the design. The remaining six ships to old Rule scantlings were slightly different in that vertical webs were fitted to the transverse bulkheads in the wing tanks and between centre line girder and longitudinal bulkheads in the centre tanks, in the same position as the previous buttresses. Also corrugated wash bulkheads were fitted in the wing tanks in way of alternate centre tank bulkheads.

A great deal of trouble experienced in the first ships of the series can be traced to the following causes and effects:—

1. Lack of vertical support to the transverse bulkheads and too large a span of these bulkheads, especially in the centre tanks where the intermediate vertical webs were not fitted. These defects were made manifest by buckling of the centre line web, which was stiffened vertically in later ships, and by fractures in the transverse bulkheads at the toes of the buttresses.

2. Non-continuity of the centre tank transverse bulkhead, where an ordinary web in the wing tanks (and where a plane wash bulkhead in the wing tanks of the 490 ft. series), causing fractures in the longitudinal bulkhead at the knuckles of corrugations in centre tank bulkheads. Vertical supporting brackets were fitted to the longitudinal bulkhead in way of these corrugation knuckles.

3. Mal-alignment of transverse bulkheads in centre and wing tanks, again shown by fractures in the longitudinal bulkhead in way of transverse bulkhead corrugation knuckles. This mal-alignment has been a great cause of trouble in all tankers with such a construction and is partly due to the tendency of the bulkhead to "concertina". In recent construction this tendency has been reduced by the extra vertical stiffening fitted, and extreme care is taken to ensure good alignment when erecting the bulkheads.

4. Many fractures in way of tripping brackets:—

(a) To vertical centre line webs on transverse bulkheads in way of toes of the brackets at bulkheads. These were well hollowed and fitted to horizontal stiffeners on the bulkheads in later ships.

(b) To wing tank side transverses and longitudinal bulkhead vertical webs, both in way of the toes of the brackets on the webs and in way of the welded connection to the side longitudinals (in side transverses). These fractures are still being experienced in tankers coming in for survey, although with the improved designs, details of which are given later, they are not so persistent. It is hoped that in the latest ships they will be eliminated completely.

5. The general rigidity of the structure in the wing tanks of the first ship, in which, as stated above, no wash bulkheads were fitted, has proved to be rather poor. The same may be said of the first two ships of the 490 ft. series, and in one of these tankers several of the side transverse webs fractured and a portion of the side shell plating became parted from the hull.

Many of these original ships have been reinforced by extra vertical stiffening in way of the wing tank transverses and in the vicinity of the junction of the longitudinal and transverse bulkheads. Tripping brackets have also been increased in size and connected to the face bars on transverses.

Fig. 10(c) shows the same tanker but with new Rule scantlings and arrangements. The increase in depth of the side shell and longitudinal bulkhead vertical webs should be noted. Five ships of this type have been built to the Society's class. Attention is drawn to the vertical stiffening fitted to web frames on corrugated bulkheads and at the junction of the longitudinal and transverse bulkheads (Fig. 10(e)), also to the "softened" tripping brackets and the continuous bar on the transverse bulkheads to take the ends of the vertical web tripping brackets (Fig. 10(d)). One of these tankers has recently undergone her first special survey without many fractures prevalent in the earlier ship being noted.

Due to the trouble experienced in the first ships of the series, the builders decided to alter the design completely, and the arrangements adopted in the last four ships are indicated in Fig. 10(f). In the light of present knowledge this would appear to be a rather good design, for support is given to all members where previous experience has shown this to be necessary. The transverse and longitudinal corrugated bulkheads have a "pillar" support in the form of balanced girders, all vertical webs to transverse bulkheads being connected to continuous girders at bottom and deck. All tripping brackets are well tapered and softened, and these are the only brackets which are connected to the bulkheads (apart from through brackets in way of shell and deck longitudinals), end brackets to primary supporting members being connected to bulkhead webs. The wing tank cross tie is in line with the side longitudinals and connected to them with hollowed brackets.

This design has formed the basis for all new designs at the yard and the 526 ft. series has been replaced by a 530 ft. type, in which, incidentally, the bottom centre line girder supports the bottom transverses and is therefore of greater depth than them. In larger tankers of 570 ft. and 580 ft., two cross-ties are fitted in the wing tanks.

Variation of Design in Different Yards

The failures indicated above in tankers built at one particular shipyard are typical, to a greater or less extent, of those experienced in tankers from other builders. Although designs may vary in the different shipyards, there are certain items that are common to all, viz: —

(i) Corrugated Bulkheads

Transverse bulkheads are either horizontally or vertically corrugated depending on yard practice. In the largest tankers the longitudinal bulkheads are made plane.

(ii) Longitudinal Side Framing Throughout the Cargo Tank Range

Only one tanker of any size has been built with transverse side framing in the last six years. In some cases the longitudinal framing extends to the extreme ends of the ship.

(iii) Electrically Welded Construction

Riveting is generally regarded as a retrograde step by shipbuilders and some owners. It is usually only at the owners' request that it is incorporated.

(iv) Scalloping of stiffening members.

(v) Prefabrication.

Figs. 11(a), (b) and (c) show the internal arrangements of three tankers built at various Swedish yards during recent years. In all three ships the vertical webs supporting the longitudinal bulkheads are efficiently stiffened in the vertical direction. The tanker shown in Fig. 11(b) has horizontally corrugated transverse bulkheads and the builders have designed a very efficient "box" pillar on which the longitudinal and transverse bulkheads terminate at their junction. The corner angles of the pillar also form a substantial ending for the bulkhead corrugations. This construction was first incorporated in a series of 18,000 tons d.w. tankers by the builders.

In tankers 11(a) and 11(c) one flange of each cross-tie is continuous from side shell to longitudinal bulkhead and terminates on the continuous horizontal stiffener which also supports the latter bulkhead in way of the ends of the transverse bulkhead stringers. These stringers are, in tanker 11(a), supported by vertical webs which are in line with longitudinal bottom and deck girders. This is a form of construction that has been greatly encouraged.

The spacing of the complete transverse rings of tanker 11(c) is 4·02 metres (13·2 ft.) and two of these are fitted in each cargo tank, while intermediate bottom transverses (three in each tank) are fitted below stringer I. Another interesting feature of this design is that the longitudinal and transverse bulkheads are made plane in the vicinity of the deck, side and bottom shell, thus forming efficient girders in these regions.

Constructional Details

At one time it was the practice in some shipyards to make the centre line bottom girder intercostal between the transverses, the latter being of adequate strength to support the bottom structure between longitudinal bulkheads. The face bar to the centre girder was sniped at the transverses producing an undesirable discontinuity of the centre girder and leading to fractures in its web. This method of construction is no longer employed, the centre girder in all cases being a continuous member supporting the transverses. One firm has gone to the other extreme, slotting the heavy centre girder face plate through the transverse bulkhead, even although the vertical centre line bulkhead web is equally disposed on either side of the bulkhead with large end brackets. (*See* Fig. 14). It is considered that this face bar could have stopped on either side of the bulkhead, without loss in efficiency.

The stiffening of the centre line bottom girder has been the subject of much discussion, the question being whether this member should be stiffened vertically or horizontally, especially in the larger tankers where this girder is of great depth. The obvious solution is to have it stiffened in both directions, and Figs. 12(b) and 12(c) show two designs that have been approved with "combined" stiffening while Fig. 12(a) indicates the more conventional design fitted in a 530 ft. tanker.

There are several different types of longitudinal commonly used in Swedish shipyards at the present time. These include flat bars, T bars of fabricated section or of Norrbotten profile, and bulb plate of Holland, Peine or Colville Section. The Norrbotten section is manufactured at a new steel works near Lulea in the north of Sweden. The use of flanged plates is not encouraged, although one firm still uses side longitudinals of this section.

Flat bar longitudinals at the bottom or deck are naturally very thick in order to obtain the required section modulus and depth to thickness ratio, but at the same time offer plenty of longitudinal area, the thickness very often approaching that of the plates to which they are attached. The welded connection to the plating is a continuous fillet weld having a minimum throat thickness equal to one quarter of the longitudinal or plate thickness, whichever is less. Some trouble was originally experienced with this type of longitudinal due to leakage though the transverse bulkheads along the longitudinal plate boundary when under test during construction, but this has been overcome by burning a semi-circular hole just clear of the transverse bulkheads, to form a welded stopper. These also serve as air holes at the deck. Drainage in way of bottom longitudinals is obtained by burning a number of holes of special shape in a portion of longitudinal having increased thickness. (*See* Fig. 13(b).)

The connection of bottom and deck longitudinals of flat plate type to bulkheads and transverses is very easily made and this type of

longitudinal greatly simplifies prefabrication, especially where bottom or deck plating plus longitudinals form one unit which are slotted into the bulkhead and transverse units. Details of these connections are given in Figs. 13(a) and 13(c), from which it will be noted that the longitudinals pass through the transverse bulkhead at the neutral axis of the vertical corrugations. By so doing it is hoped to reduce the possibility of fractures occurring at the ends of the longitudinals.

The arrangements in way of the transverse bulkheads with longitudinals of other form is not so simple, especially at the bottom where the loading is increased and access for cleaning, drainage etc., have to be considered. Several different methods used are illustrated in Figs. 15(a), (b) and (c).

The small bracket on one side of the bulkhead fitted on top of the bracket continuous through the bulkhead (Fig. 15(a)) was introduced due to the bulkhead fracturing at the upper edge of the latter bracket. The same applies to the construction shown in Fig. 15(b), where in previous tankers the bottom longitudinals merely butted on either side of the bulkhead, and fractures occurred at the toes of the "T" bar longitudinal flanges.

Corrugated longitudinal bulkheads should be of sufficient strength to take their load for the full span between transverses or between transverse and bulkhead. This means that the practice, which was at one time quite common in Sweden, of having "half depth" corrugations in longitudinal bulkheads adjacent to, and sometimes a fair distance from, the deck and bottom shell is strongly discouraged if these corrugations are of insufficient strength to support the load which they are required to bear. In such a case these "half depth" corrugations will need to be supported at their mid-length by a vertical bracket extending over at least two bottom longitudinals at its base if the corrugation is well above the bottom shell. Furthermore, the plane bulkhead clear of the corrugated region has to be adequately stiffened and vertical stiffening has proved unsuccessful. Fractures have occurred in the bottom longitudinal bulkhead plating at the ends of both brackets and stiffeners described above.

Webs supporting corrugated bulkheads can have either the bulkhead plating as one of their flanges (Fig. 16(a)), referred to as an "unbalanced girder" in what follows, or can have two face plates with the bulkhead central (Fig. 16(b)), referred to as a "balanced girder". Of the two, the balanced girder is undoubtedly the best and the yards have been strongly recommended to use this type of construction. A balanced girder forms an excellent pillar when it is either vertical or horizontal, and this is especially desirable when it is a matter of support between bottom and deck with horizontally corrugated transverse and longitudinal bulkheads. The bulkhead plating is not called upon to function as a girder flange as well as a bulkhead stiffener and good alignment and fitting between the webs on either side of the bulkhead is readily obtained as these are generally burned from the same plate and prefabricated in the shop where accurate lining off can be made. Another advantage of the balanced girder is that the supporting brackets are smaller than those fitted to an unbalanced section with a consequent reduced load being transmitted to the bulkhead, (Fig. 17).

Trouble has been experienced in recent years in cases where the horizontal girders on vertically corrugated transverse bulkheads have been made shallow with heavy face bars, or the spacing of the supporting and stiffening brackets has been large. Fractures have occurred in way of the connection of web to bulkhead and it has been found necessary to stiffen up these girders by fitting a stiffener to the web, parallel to the face bar. In one tanker, not classed with the Society, all the transverse bulkhead girders were reinforced, the depth of the girders being increased by fitting a deep angle on the other side of the bulkhead.

The connection of the end bracket of a horizontal girder to the longitudinal bulkhead in a tanker with vertically corrugated transverse bulkheads should be made to a horizontal stiffener on the longitudinal bulkhead, for otherwise the load at the toe of the bracket would undoubtedly cause the latter bulkhead to fracture. Fig. 11(c) is a typical example of a type of construction that has been approved in Sweden.

Special attention has been paid to tripping brackets to corrugated bulkhead primary supporting members, for these can cause trouble if they are not properly designed, that is to say well hollowed with tapered ends. Figs. 17 and 19 give details of Swedish practice. Here it may be mentioned that every attempt has been made to reduce to a minimum the number of members ending directly on a corrugated bulkhead.

Turning now to the gunwale connection, it is the exception rather than the rule to make this of a riveted angle. The practice of making this connection of a rounded plate is becoming increasingly popular, and in one yard it has been standard practice for all types of ships built there since 1950. The rounded gunwale plate can be rolled hot or worked cold, and quite naturally the latter method is preferred by the yards as it is far cheaper than the former. If the plate is rolled hot the radius may be about 500 mm., but if cold working is used the radius should be increased to 700–800 mm. depending on the plate thickness, the plate being "knuckled" every 40 mm. along its circumference and the radius of the former used being at least equal to the distance between the knuckles. The end plates generally require to be shaped hot and normalised afterwards. There are various ways in which the transition from round to angular section may be made (*see* Fig. 20). It has been the practice, wherever possible, to keep this transition region outside the midship half length.

Another problem that arises when rounded gunwales are fitted is that of the connection of the bridge sides to the deck. Generally the bridge sides are "set in" and the side plating can be either carried straight down and welded to the gunwale or set in further so that the new recessed plate falls clear of the rounded gunwale (Fig. 21). In the latter case Owners sometimes do not like the appearance of the construction and prefer to carry down the house side to within close proximity of the gunwale, thus forming a pocket, access to which can be obtained by fitting manholes in the house side. Where the rounded gunwale is carried well aft, it is sometimes the practice to keep the poop front clear of the round, although here again the poop front has been carried out over the round.

Trends in Design

Several tankers have already been constructed, and many are on order without midship houses, the first being one of 23,000 tons d.w. built in 1954. The Swedish Authorities require a fore and aft gangway to be fitted in such ships, for use of the look-out forward. It is also of use for access to a midship pump room, if fitted, apart from acting as a support for the various fore and aft pipes. In the case of tankers with all houses aft there has been much discussion regarding compliance with the requirements of the International Convention for the Safety of Life at sea for lifeboats in tankers over 4,000 tons, and the Swedish Authorities permit life rafts to be fitted amidships in such ships, all lifeboats being fitted aft.

The advantages of having all accommodation aft are obvious and these may be compared with all accommodation amidships in dry cargo ships with machinery amidships. Due to one extra tier of houses being fitted aft, the transverse strength in this region calls for special attention, care being taken to ensure that the house-side webs are substantial, reasonably in line and carried down into the main structure.

It might be thought that difficulty would be experienced in navigating a large tanker from aft, but there does not seem to be any adverse criticism from officers who have had experience with this type of ship. One tanker recently delivered has a television camera fitted in the fore mast with a view forward which is transmitted to a screen in the navigating bridge aft.

The position of the pump room is another controversial point, and it is understood that the tendency in the future will be to fit it immediately forward of the engine room. Although this is not satisfactory from the point of view of longitudinal strength, it appears to have many advantages, especially in the case of tankers having turbine machinery, in which case the cargo pumps are driven by shafts passing through the bulkhead between engine and pump rooms.

LARGE TANKERS

The largest tankers at present on order (the keel of the first has been laid) in Sweden are six for American owners, with dimensions 782 ft. × 116 ft. × 56 ft. These ships will have three longitudinal bulkheads.

Another firm has an order for three 705 ft. tankers while five tankers 703 ft. in length are to be built in a special dry dock which is at present being blasted out of solid rock at another shipyard.

ORE CARRIERS

The Development of the Modern Ore Carrier

It is proposed to deal only with iron ore carriers, for although several bauxite carriers have been built in Sweden during recent years, it would not be correct to say that this is a type in which the industry specialises.

One of the principal exports from Sweden is iron ore, the greatest volume being through Narvik (Lulea in summer), from the mines around Kiruna in the north, while ore from the mines in central Sweden is exported through Oxelösund, south of Stockholm. The largest fleet of Swedish ore carriers is that of the Grängesberg-Oxelösund Company, which at one time had controlling interest in the mines at Kiruna and still owns those in the Bergslags area in central Sweden.

Up to the early part of the last war, the ore carriers built were of modified cargo ship design, with machinery amidships. These ships are engaged on the run from Narvik or Oxelösund to Continental or British ports and have proved to be very satisfactory in service, although some trouble has been experienced in the neighbourhood of the deep tank immediately forward of the engine room.

During the war, work was started on several ore carriers about 460 ft. in length having machinery aft, centre line ore holds and wing tanks suitable for the carriage of oil cargoes. Of the first four to be built two were transversely framed throughout while the other two were longitudinally framed at the deck and had transverse framing elsewhere. If these ships were to be built at the present time, the very thick deck plating (31,5/32,5 mm.) would require to be of special quality steel, especially in view of the fact that the structure is all welded. Ordinary steel was fitted and what is more it was "war-time" steel which was perhaps not of the best quality. It is therefore not surprising that fractures have occurred in all four ships at the deck, which in every case has been reinforced, freed and riveted. After the two ore carriers having transverse deck beams had been reinforced, waviness developed in the bottom shell plating, which was stiffened. The other two have had very little trouble in the bottom shell, except in way of the midship pump room, where the change in longitudinal strength was perhaps rather sudden.

Two later ore carriers of rather unusual design have very long poops with an extension in way of the centre ore holds to amidships. An expansion joint is fitted in this extended portion. The wing tanks can be used for the carriage of oil cargoes, and these tanks extend to the poop deck aft, the upper deck being perforated. Ore cargoes can be carried to poop deck level from the fore end of the machinery space to the centre line poop extension amidships. These ships are longitudinally framed and have been successful in service, apart from trouble in way of the expansion joints.

Finally we have the modern type of iron ore carrier, the prototype of which was built in 1953, is 605 ft. in length with a deadweight of 26,000 tons. Only one ship of this type has been built (a sister ship is at present under construction) but of a 560 ft. type three have been built at one yard and five at another with two more on order. At the present time a series of three 630 ft. ships are on order from one yard. All these ships are classed "Ore carrier, carrying petroleum in bulk in wing tanks when no cargo in adjacent centre compartment", so that it is permissible for them to carry ore to the United States and return with an oil cargo to Europe. Another point is that the original design of these ships was for the Grängesberg Company, although some later ships in the 560 ft. series were built for another Swedish shipowning company. The limiting draught for ships using Narvik is 35 ft. and although in some cases it would be permissible to have more draught than this with a tanker freeboard, this possibility has never been made use of in the above ships.

Recent Designs

Fig. 23 gives details of the 630 ft. ore carriers mentioned above, from which it will be noted that longitudinal framing is fitted throughout, i.e. at side shell and longitudinal bulkheads as well as at bottom and deck. The spacing of transverses under ore holds is limited by rule to eight feet, and in these ships approval has been given to an 8 ft. spacing of bottom and lower side transverses with a 16 ft. spacing of deck and upper side transverses. This approval was based upon the fact that there is only one deck transverse in each side tank, the stresses in the longitudinals being not greater than with two transverses in a 32 ft. tank length. The longitudinal bulkheads extend in one plane down to the bottom shell, perforations and drainage being arranged in the part beneath the level of the ore hold.

In the part of this paper dealing with oil tankers, details are given of the evolution of the present design of a 526 ft. tanker at a certain shipyard. These builders also have a series of ore carriers based upon this tanker design, the first of which was built for American owners to carry iron ore from Puerto Ordaz, Venezuela to Baltimore, U.S.A. The depth and breadth of these ships are the same as the corresponding tanker but the length has been increased to the maximum allowable, i.e., that equivalent to $L/D = 14$, or 549·5 ft. in this instance. It will be noted from the midship section for this ship (Fig. 22) that it was considered desirable that an extra cross-tie should be fitted in the wing tanks, in line with the ore hold bottom. The wing tanks and tanks under the cargo hold are separate in this design and an interesting feature is the fore and aft passageway which runs the whole length of the vessel in the centre line beneath the ore hold. Although the first ship in the series had a midship deckhouse, this has been omitted in later designs, all accommodation being arranged aft.

With regard to the structural design of ore carriers in general, it is considered that transverse bulkheads in the side tanks and where completely athwartships may be vertically or horizontally corrugated, but the transverse members under the ore hold must be plane, the intermediate webs being either plain perforated with vertical stiffeners or transverse tank top and bottom girders with webs at longitudinal bulkhead and centre girder.

BULK CARRIERS

Type Built

As stated previously, large quantities of iron ore are exported from Sweden, and as there are only several small coal mines in the country, the major part of the coal required must be imported. The Swedish type of bulk carrier has thus been developed with a view to the transport of iron ore and coal, with the import of grain to Western Europe as another consideration. The carriage of ore on the one hand and coal or grain on the other impose conflicting demands upon the transverse area of the cargo hold, for while the cross-sectional area is restricted in order to obtain the "ore carrier" notation, the maximum area is required for the other cargoes. As it is quite common for these ships to sail in ballast when employed on certain routes, the space clear of the cargo hold is utilised for the carriage of water ballast.

Two yards received approval for bulk carriers of different design almost simultaneously in 1954, and for the one type ten ships have been ordered (five already in service), while for the other, six ships have been ordered (three in service), to the Society's class.

Constructional Details

The midship section of a typical Swedish bulk carrier is shown in Fig. 24. As the sloped upper portion of the longitudinal bulkhead forming the boundary of the ballast tanks is virtually a second deck at less than standard height below the upper deck, no great difficulty is experienced in obtaining the required top-side area, the very favourable L/D ratio in this type of ship being another advantage. Care must, however, be taken to ensure continuity of strength at the poop front,

where it is usual for the longitudinal bulkhead to terminate. The intermediate bottom transverses, which are of the same scantlings as the main transverses, are carried up to the upper turn of the bilge.

An interesting feature of the design is the grain shoot and feeder abreast the hatchway opening, with which are associated hinged steel grain bulkheads which can be swung out from their stowed position against the longitudinal bulkheads when required.

In a recent design, similar to but of greater length, etc., than the above, approval has been given to a 6·5 ft. spacing of bottom transverses in association with a 13 ft. spacing of deck transverses, which are formed of completely plated webs between deck and longitudinal bulkhead.

Details of Service Experience

None of these ships have been in service for a sufficient length of time to obtain an overall picture of their qualities. There are, however, several features that have already shown themselves to be prominent.

In the type for which the midship section is given, the longitudinal plate forming the inner boundary of the grain shoot was attached to the transverse bulkheads when built. Fractures occurred at the junction between the two members, which were accordingly freed from each other, and no further trouble has been experienced.

The first two ships of another series both had trouble of a similar kind. In these ships the whole of the bottom plating forward including the supporting transverses was set up, and they were reinforced by fitting extra support between bottom shell and tank top in the effected area (*see* Fig. 25). Later ships were built to the requirements of the ore carrier Rules, having a closer spacing of floors and more efficient support between shell and tank top.

The general complaint about the bulk carrier type is that when carrying iron ore they have a very "jerky" motion in a seaway due to the large metacentric height, which makes them rather unpleasant to sail in. It is understood that in one ship the carpets in the accommodation moved across the deck under certain sea conditions. The whole problem has become rather a serious one, and the Owners have considered several ways of overcoming the trouble. A quite successful solution is to stow the ore cargo up against the transverse bulkhead instead of centrally in the hold, (*see* Fig. 26). It is understood that by using this method the period of roll has been increased from about three to about seven seconds. The danger with this arrangement is that the transverse bulkheads were not designed to take the punishment of ore and grabs, and no doubt these will require repair sooner than was originally intended. A design has recently been submitted in which the transverse hold area has not been restricted in order to obtain the "ore carrier" notation, but the length of the ore holds has been reduced so that the ore stows with a higher centre of gravity. An arrangement is so formed with alternate short ore holds, the intermediate long holds being used for coal or grain cargoes.

Comparison of Different Ships Built or Designed

Table 3 gives details of the four different types of bulk carrier that have been designed by Swedish shipyards during recent years. It will be noted that the ships have very similar proportions, especially Nos. 2, 3 and 4.

With regard to longitudinal strength, this is very favourable in this type of ship, due to the long cargo hold and disposition of ballast tanks abreast the holds. In ship No. 1 it was originally decided to keep No. 1 wing tanks empty during ballast voyages in order to reduce the hogging bending moments to a minimum, but experience has shown that these require to be filled to get the ship's head down. The stress is still satisfactory with these tanks ballasted.

The deck areas for ships of this type are not readily obtainable from the Rules, and it is usual to make a section modulus computation in order to verify that the required standard is obtained. A method for obtaining an approximate deck area has, however, been evolved for ships of types 2, 3 and 4. All the area of the topside material including sloped bulkhead has been assumed concentrated in a horizontal line through the upper deck at side giving an "equivalent" deck area. The section modulus at deck is then proportional to deck area multiplied by D, and it has been found, for ships of this type, that the section modulus of the side shell plus longitudinal bulkhead together with all adjoining longitudinals is 8 to 9 per cent of the total. Assuming a section modulus of 18 per cent in excess of that required by load line convention, and a d/D ratio of ·71, the required equivalent deck area is ·38 fB, where f is the load line strength factor. If any variation is required in the section modulus, the new deck area can be obtained by increasing or decreasing the equivalent deck area by the percentage increase or decrease in section modulus. Table 3 shows that the areas obtained give a reasonable approximation to those actually required.

TABLE 1. TABLE SHOWING ANNUAL PRODUCTION OF THE LEADING SHIPYARDS THROUGHOUT THE WORLD DURING RECENT YEARS IN ORDER OF GROSS TONNAGES LAUNCHED

1933		1951		1952		1953		1954		1955		1956		1957	
	Tons		Tons		Tons		Tons		Tons		Tons		Tons		Tons
Götaverken . .	**47,192**	**Kockums**	**119,000**	**Kockums**	**131,996**	Deutsche Werft .	145,769	Newport News .	191,000*	Deutsche Werft .	162,405	Mitsubishi, Nagasaki. . .	198,000	Mitsubishi, Nagasaki. .	236,970
Mitsubishi . .	43,567	Harland&Wolff, Belfast	118,554	Harland&Wolff, Belfast	130,781	Howaldtswerke, Kiel	129,257	Deutsche Werft .	164,525	**Götaverken** . . .	**123,056**	Deutsche Werft .	143,779	National Bulk Carriers,Kure .	205,349
Nederlandsche	26,322	**Götaverken** . . .	**109,965**	Bethlehem, Sparrows Point	124,402	**Kockums**	**127,194**	Howaldtswerke, Kiel	161,380	Harland&Wolff, Belfast	122,768	Mitsubishi, Yokohama . .	129,540	Kawasaki . .	165,050
Lithgows. . .	23,036	Swan Hunter . .	98,793	**Götaverken** . . .	**104,341**	Bethlehem, Sparrows Point	125,093	**Götaverken** . . .	**140,495**	**Kockums**	**122,187**	**Götaverken** . . .	**124,396**†	Howaldts-werke, Kiel .	164,291
d'Adriatico . .	20,865	Furness	90,460	Deutsche Werft .	103,345	**Götaverken** . . .	**117,530**	**Eriksberg** . . .	**126,392**	**Eriksberg** . . .	**106,827**	Harima	124,130	**Eriksberg** . .	**163,045**

NOTES

1. Figures are taken from *Glasgow Herald* Trade Review
2. In general, tonnages for Naval Construction are not included (*see* notes 3 & 4)
3. *An aircraft carrier of 60,000 tons is included in this figure
4. †Three destroyers are included in this figure

TABLE 2. CARGO SHIPS IN BALLAST CONDITION

SHIP No.	1*	2	3	4	5†	6‡	7	8	9**	10
Dimensions	470′ × 68′ × 41′ 6″	455′ × 63′3″ × 36′6″	450′ × 61′ × 40′ 1″	450′ × 66′ × 42′ 6″	430′ × 65′ × 39·1′	345′ × 50′ 6″ × 30′	344′6″×50·4′×32·1′	320′ × 50·8′ × 31·2′	312′ × 47′ 6″ × 28′	306·2′ × 47′ × 27′5″
Cb loaded	·63	·72	·75	·70	·70	·67	·69	·765 at ·85D	·71	·68 at ·06L
Hull Weight	4,450 Tons	3,800 Tons	4,210 Tons	4,520 Tons	4,130 Tons	1,960 Tons	1,965 Tons	1,968 Tons	1,600 Tons	1,475 Tons
Machinery	1,000 ,,	551 ,,	660 ,,	680 ,,	900 ,,	366 ,,	425 ,,	344 ,,	282 ,,	325 ,,
Fresh Water	35 ,,	87 ,,	65 ,,	115 ,,	72 ,,	50 ,,	153 ,,	41 ,,	68 ,,	21 ,,
Oil Fuel	594 ,,	326 ,,	237 ,,	450 ,,	390 ,,	100 ,,	326 ,,	82 ,,	363 ,,	62 ,,
Ballast	1,463 ,,	3,704 ,,	3,150 ,,	2,497 ,,	680 ,,	387 ,,	857 ,,	1,363 ,,	548 ,,	500 ,,
Ballast △	7,712 ,,	8,532 ,,	8,382 ,,	8,362 ,,	6,256 ,,	2,914 ,,	3,789 ,,	3,830 ,,	2,929 ,,	2,415 ,,
Bending Moment .	120,700 Tons ft.	81,500 Tons ft.	77,200 Tons ft.	125,500 Tons ft.	65,000 Tons ft.	33,500 Tons ft.	43,000 Tons ft.	29,000 Tons ft.	30,700 Tons ft.	24,150 Tons ft.
Section Modulus . .	30,850 in ^{2}ft.	21,520 in ^{2}ft.	24,100 in ^{2}ft.	25,950 in ^{2}ft.	22,450 in ^{2}ft.	9,290 in ^{2}ft.	10,360 in ^{2}ft.	8,530 in ^{2}ft.	6,890 in ^{2}ft.	6,490 in ^{2}ft.
Ballast Stress . . .	3·9 Tons/sq. in.	3·8 Tons/sq. in.	3·2 Tons/sq. in.	4·8 Tons/sq. in.	2·9 Tons/sq. in.	3·6 Tons/sq. in.	4·15 Tons/sq. in.	3·4 Tons/sq. in.	4·45 Tons/sq. in.	3·7 Tons/sq. in.
Ballast d/L	·033	·033	·034	·033	·032	·027	·035	·033	·037	·031

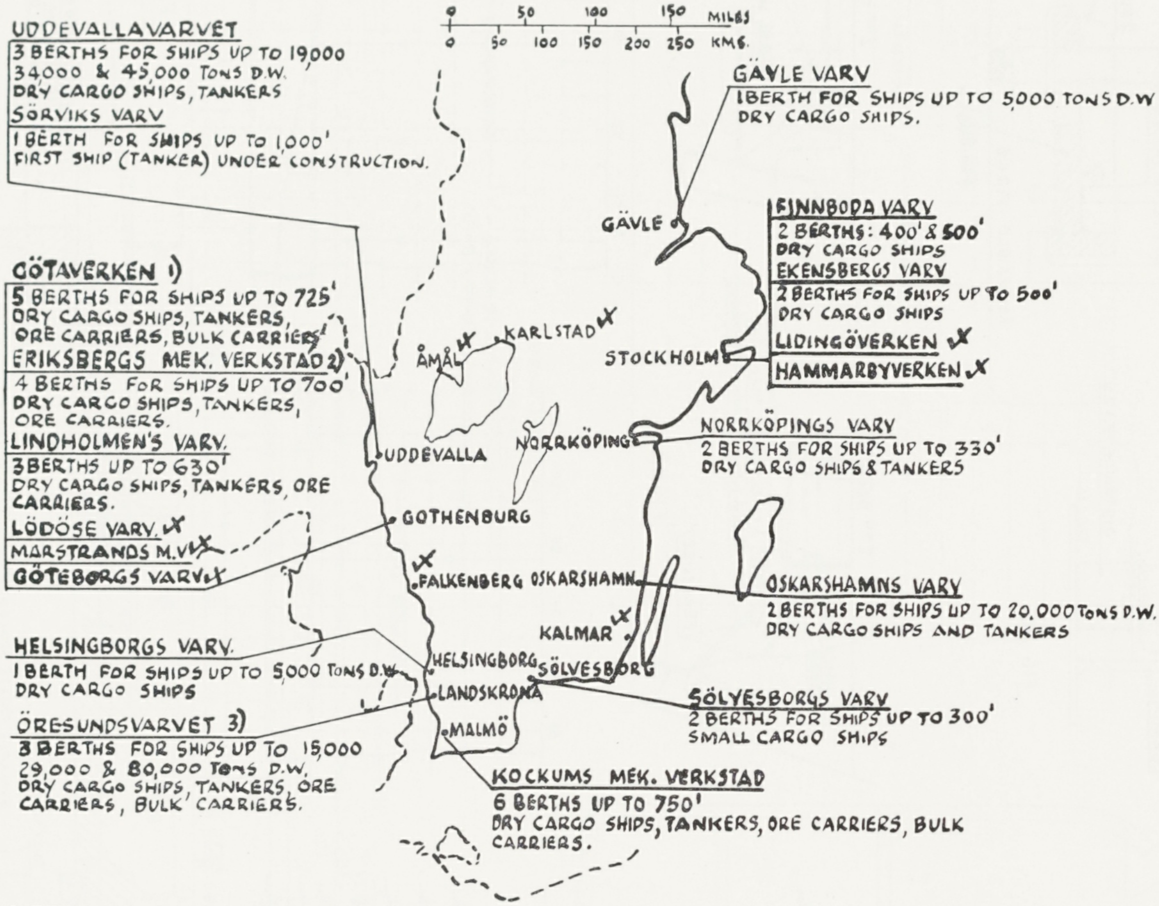
NOTES

* With forward deep tank empty, stress = 3·4 Tons/sq. in.
† Builders agreed to leave upper forepeak tank empty. Figures are for this condition
‡ Draught restricted due to trim with tanks aft full
** Midship deep tank fitted at Society's request

TABLE 3. BULK CARRIERS

Ship No.	L	B	D	Draught d	L/D	d/D	l/L*	C_B Loaded	·38 f B†	Area Fitted at LLC+18%
	ft.	ft.	ft.	ft.					sq. in.	sq. in.
1	460	64	42·5	27·17	10·80	·639	·684	·793		
2 ‡	485	65·3	42·0	29·84	11·55	·710	·726	·805	383	380
3	500	70·5	44·25	31·65	11·30	·715	·724	·79	438	436
4 ‡	550	73	48·0	33·80	11·47	·704	·71	·80	524	538

Note: * l = Length of cargo hold
† Corrected for d/D ratio
‡ Not yet built



NOTES
1) A NEW YARD HAS BEEN PLANNED, BUT WORK NOT YET COMMENCED
2) A BUILDING DOCK FOR TANKERS UP TO 70,000 TONS D.W IS UNDER CONSTRUCTION.
3) 80,000 TON BERTH WILL BE COMPLETED IN 1959
✗ YARDS BUILDING SMALL CARGO SHIPS, TUGS, etc.

FIG 1 SWEDISH SHIPYARDS

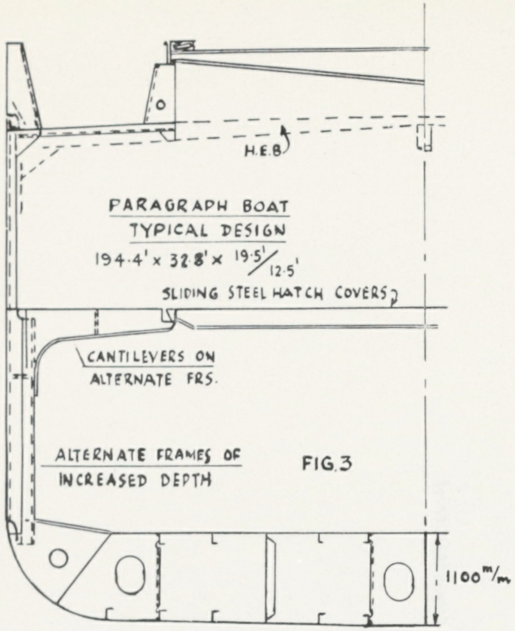


FIG. 3

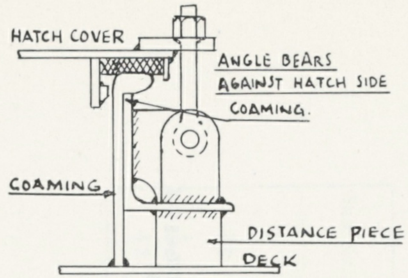


FIG 2(a)

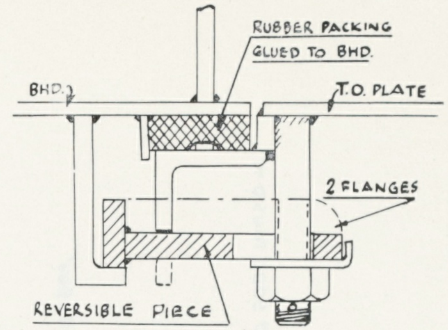


FIG 2(b)

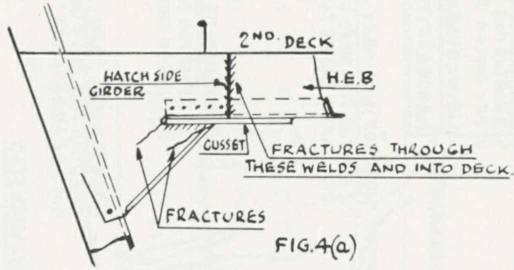


FIG. 4(a)

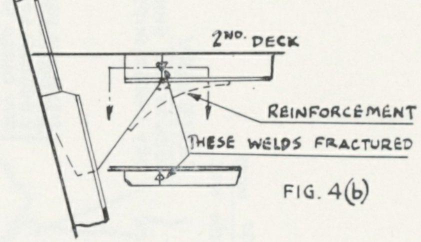


FIG. 4(b)

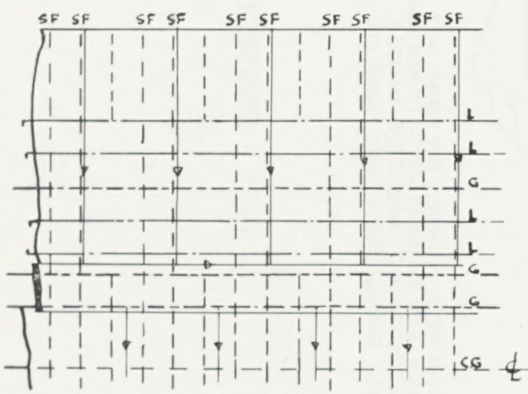


FIG. 5(a)

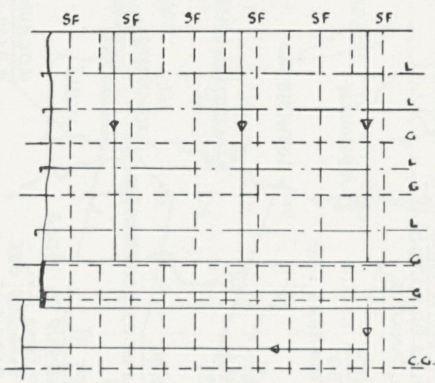


FIG. 5(b)

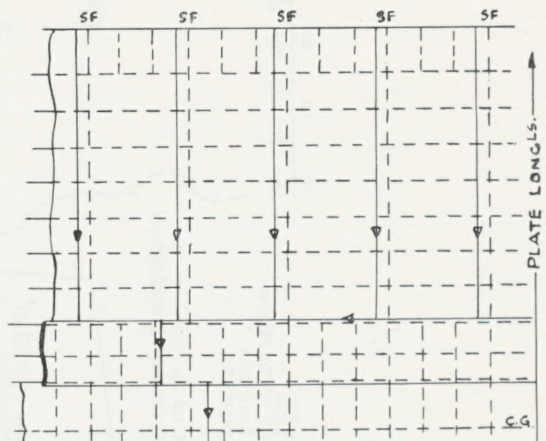


FIG. 5(c)

SF = SOLID FLOOR
L = LONGITUDINAL STIFF.R
G = —do.— GIRDER

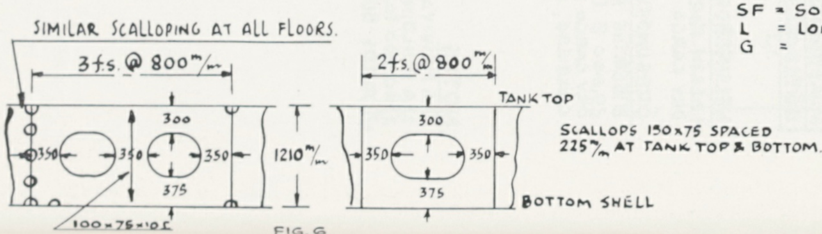


FIG. 6

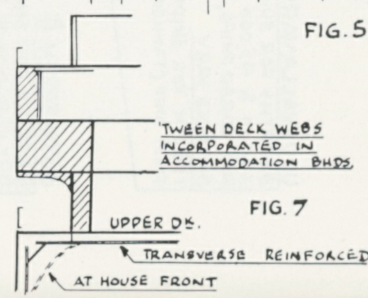
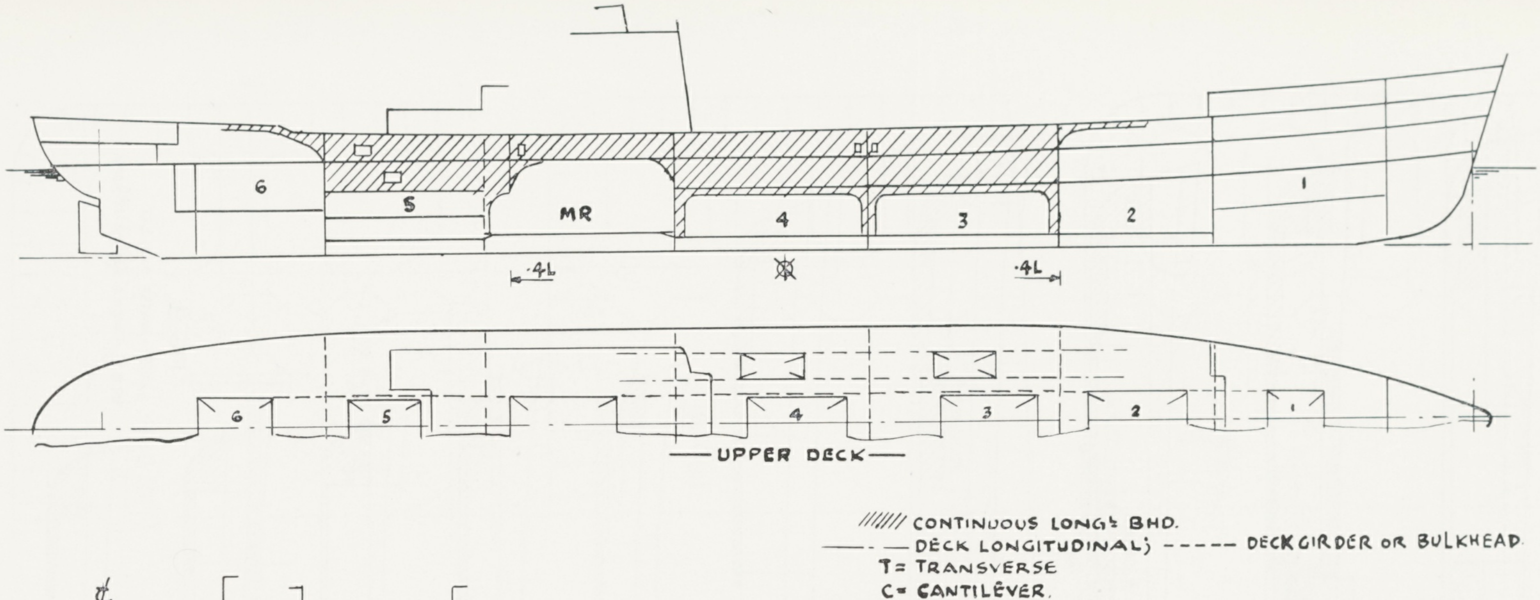
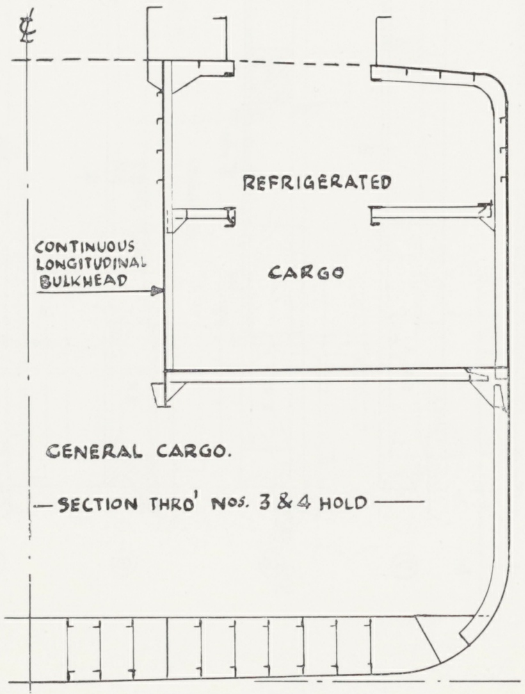


FIG. 7


6
5
MR
4
3
2
1
·4L
·4L
6
5
4
3
2
1
— UPPER DECK —
CONTINUOUS LONG^L BHD.
DECK LONGITUDINAL; ---- DECK GIRDER OR BULKHEAD
T= TRANSVERSE
C= CANTILEVER.


℄
REFRIGERATED
CARGO
CONTINUOUS LONGITUDINAL BULKHEAD
GENERAL CARGO.
— SECTION THRO' Nos. 3 & 4 HOLD —

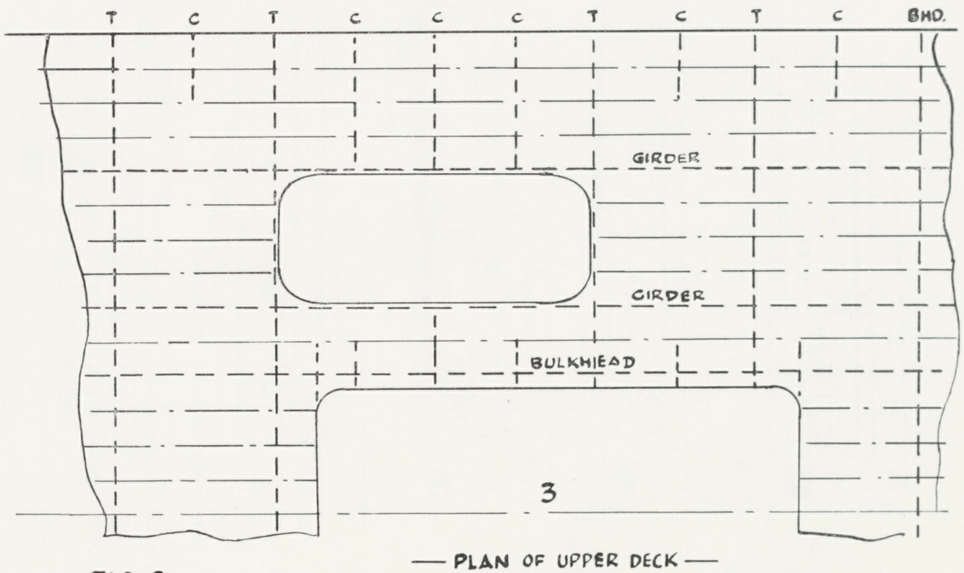

T C T C C C T C T C BHD.
GIRDER
GIRDER
BULKHEAD
3
— PLAN OF UPPER DECK —

FIG. 8

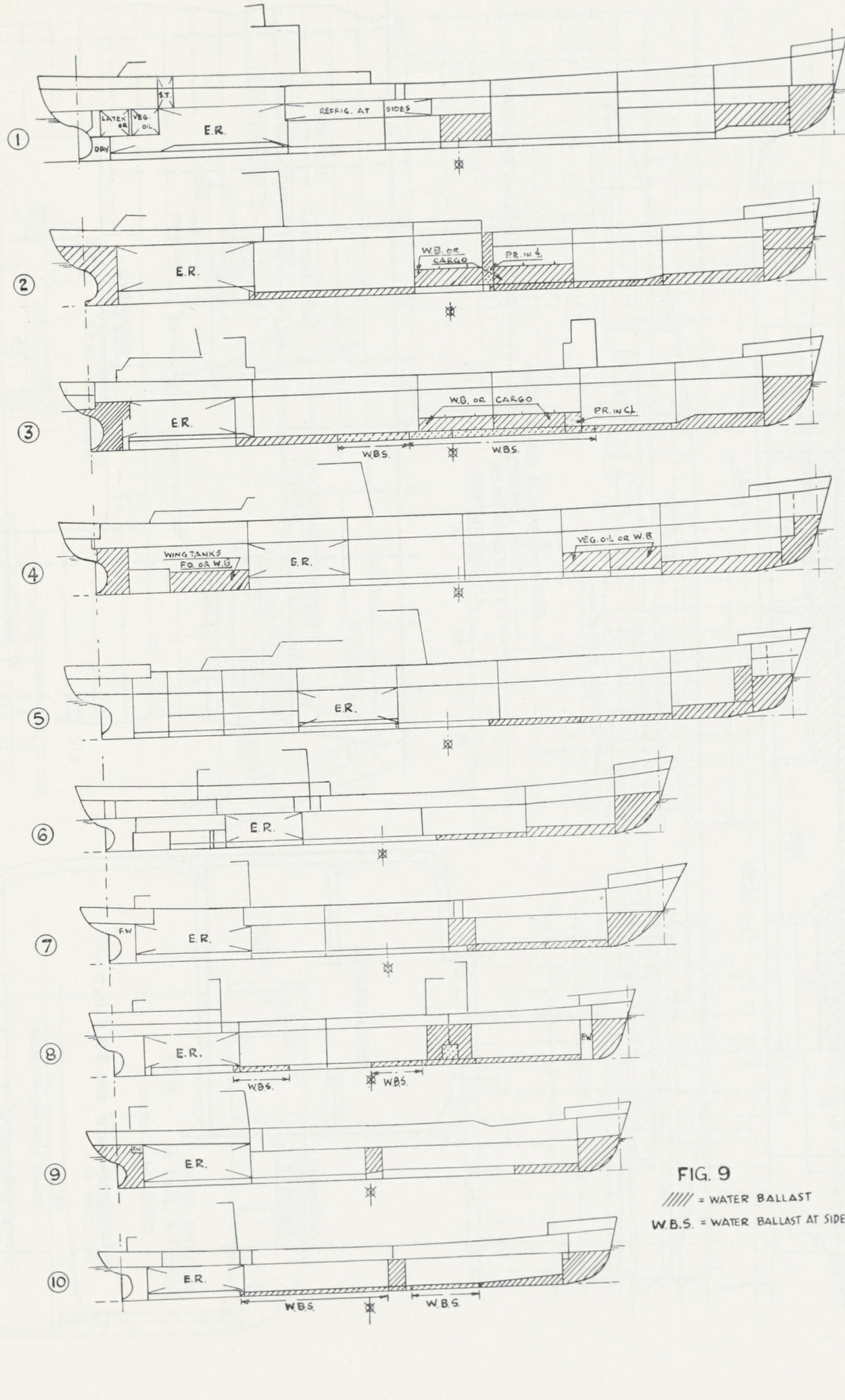


FIG. 9

//// = WATER BALLAST

W.B.S. = WATER BALLAST AT SIDES

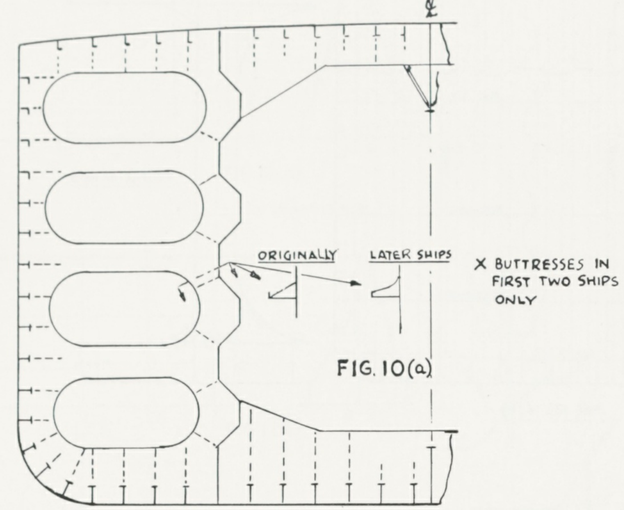


FIG. 10(a)

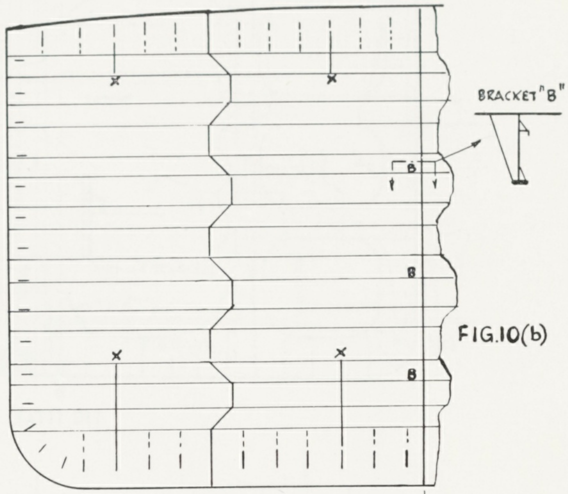


FIG.10(b)

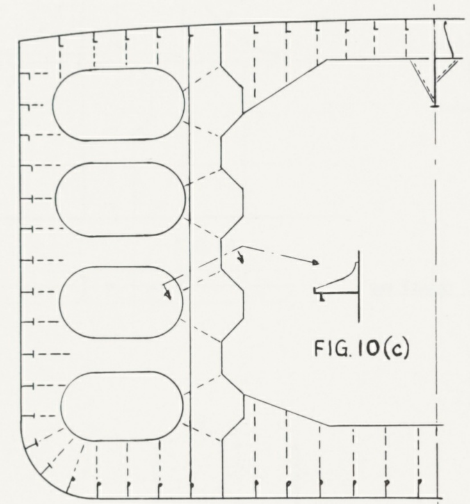


FIG. 10(c)

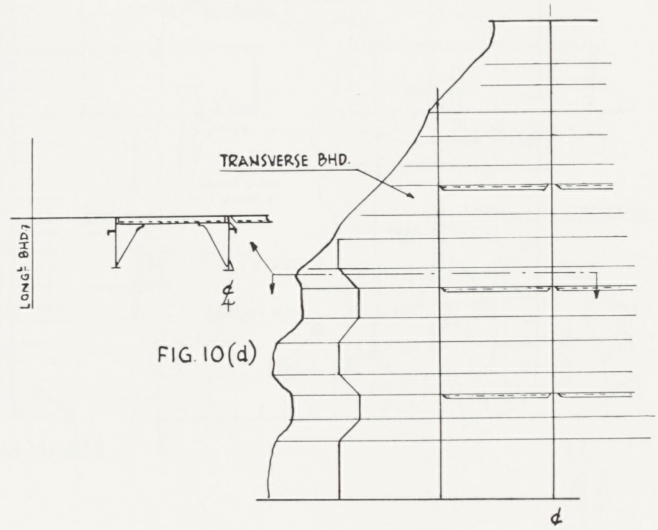


FIG. 10(d)

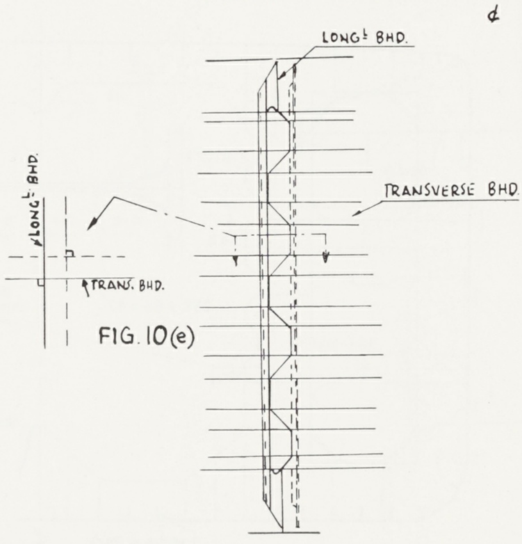


FIG. 10(e)

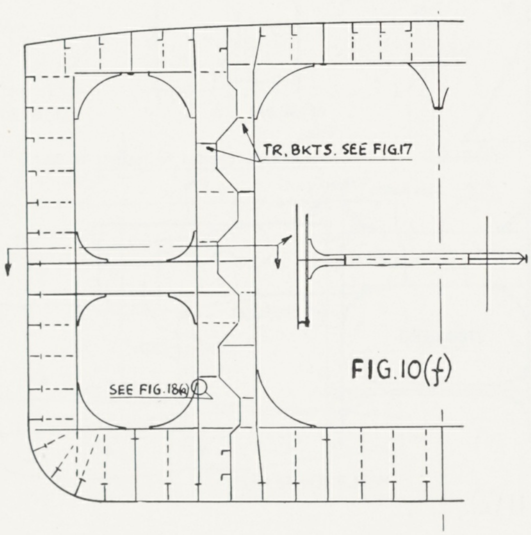


FIG.10(f)

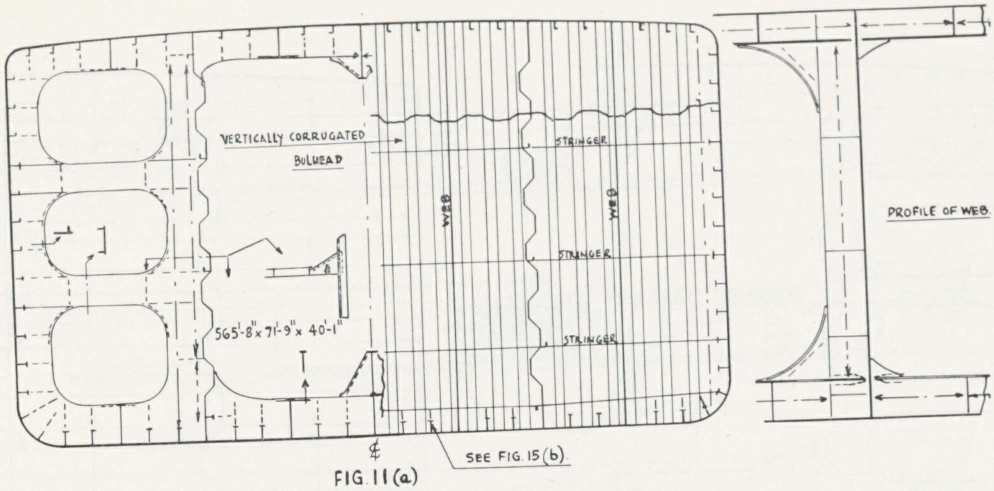


FIG. 11 (a)

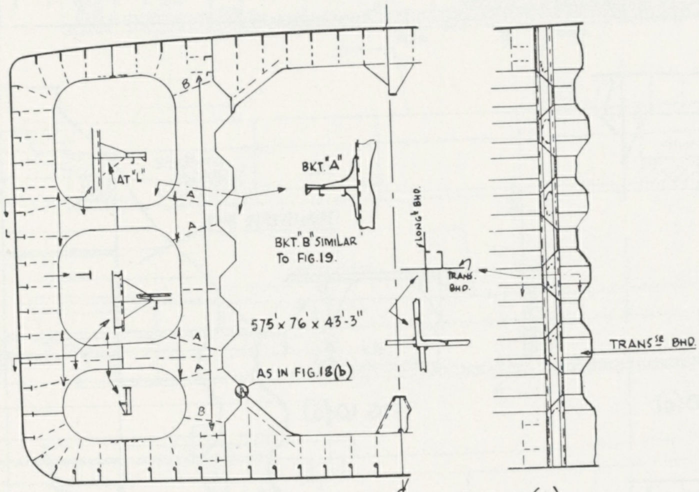


FIG. 11 (b)

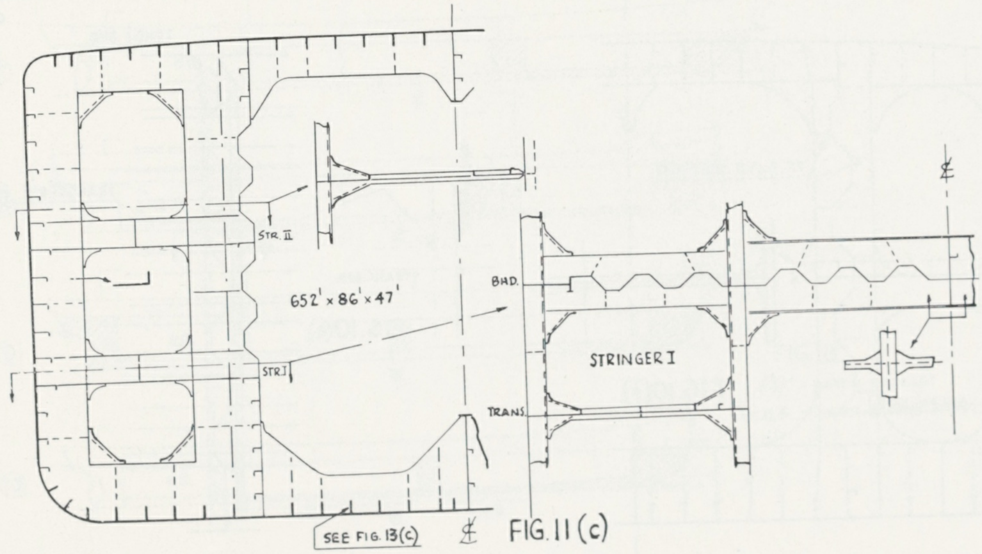


FIG. 11 (c)

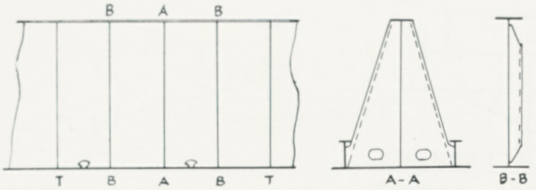


FIG. 12 (a)

T= TRANSVERSE

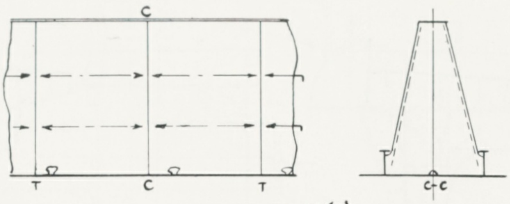


FIG. 12 (b)

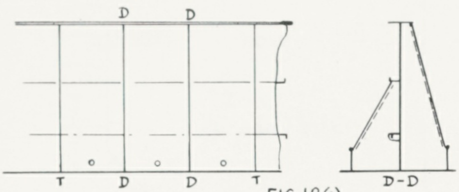


FIG. 12 (c)

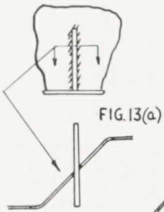


FIG. 13 (a)

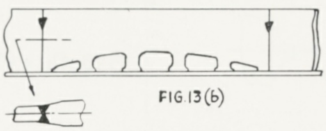


FIG. 13 (b)

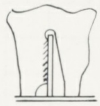


FIG. 13 (c)

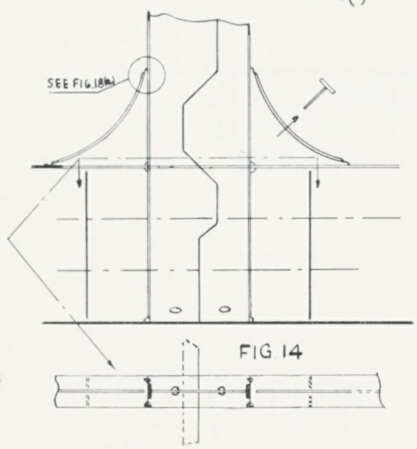


FIG. 14

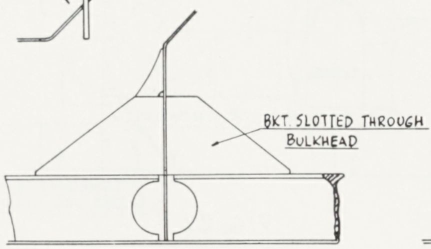


FIG. 15 (a)

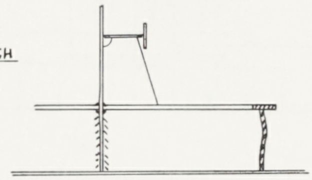


FIG. 15 (b)

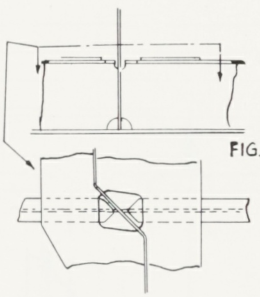


FIG. 15 (c)

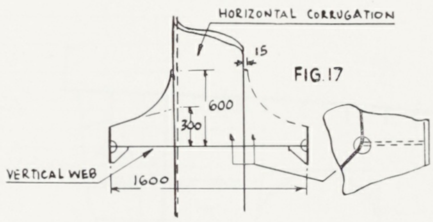


FIG. 17

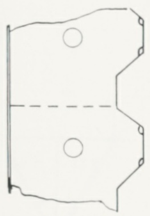


FIG. 16 (a)

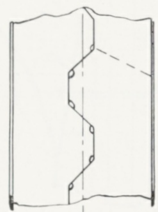


FIG. 16 (b)

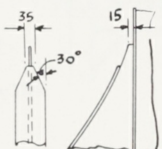


FIG. 18 (a)

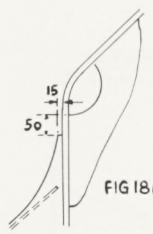


FIG. 18 (b)

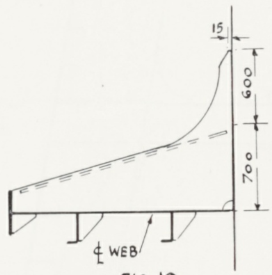


FIG. 19

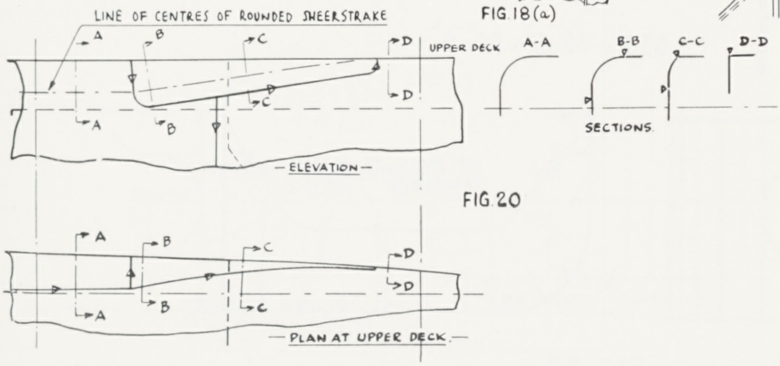


FIG. 20

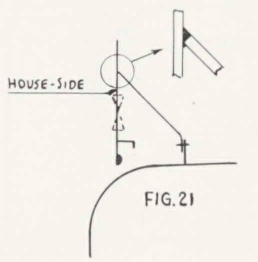


FIG. 21

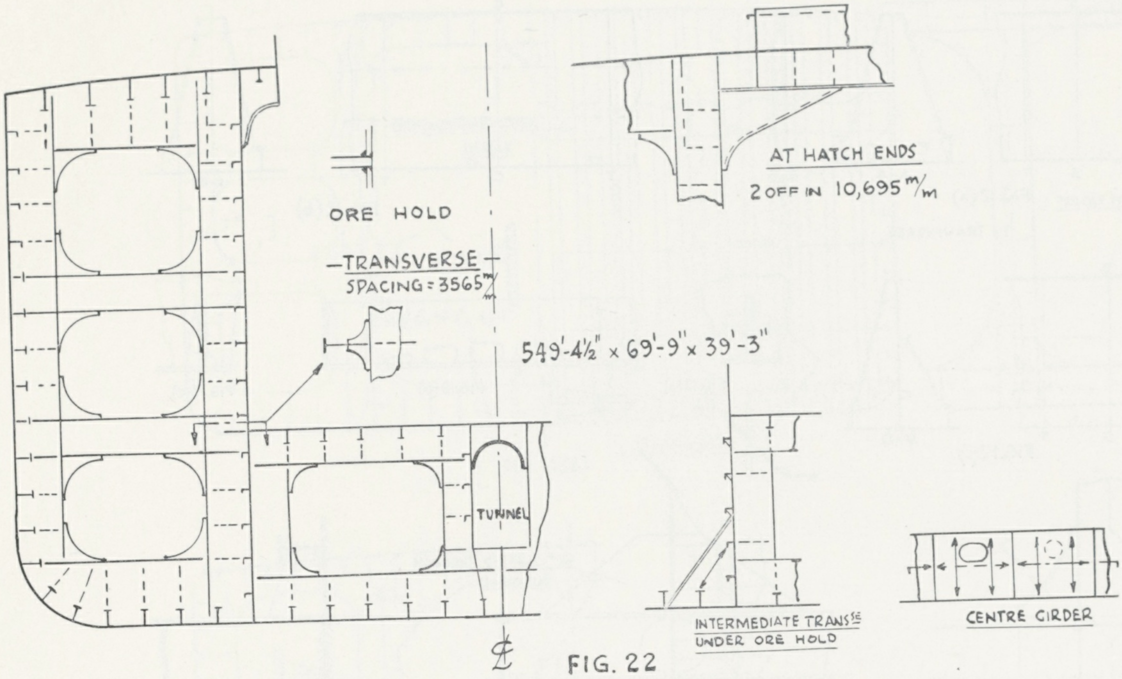

AT HATCH ENDS
2 OFF IN 10,695 m/m
ORE HOLD
TRANSVERSE
SPACING = 3565 m/m
549'-4½" x 69'-9" x 39'-3"
TUNNEL
INTERMEDIATE TRANSSE
UNDER ORE HOLD
CENTRE GIRDER

FIG. 22

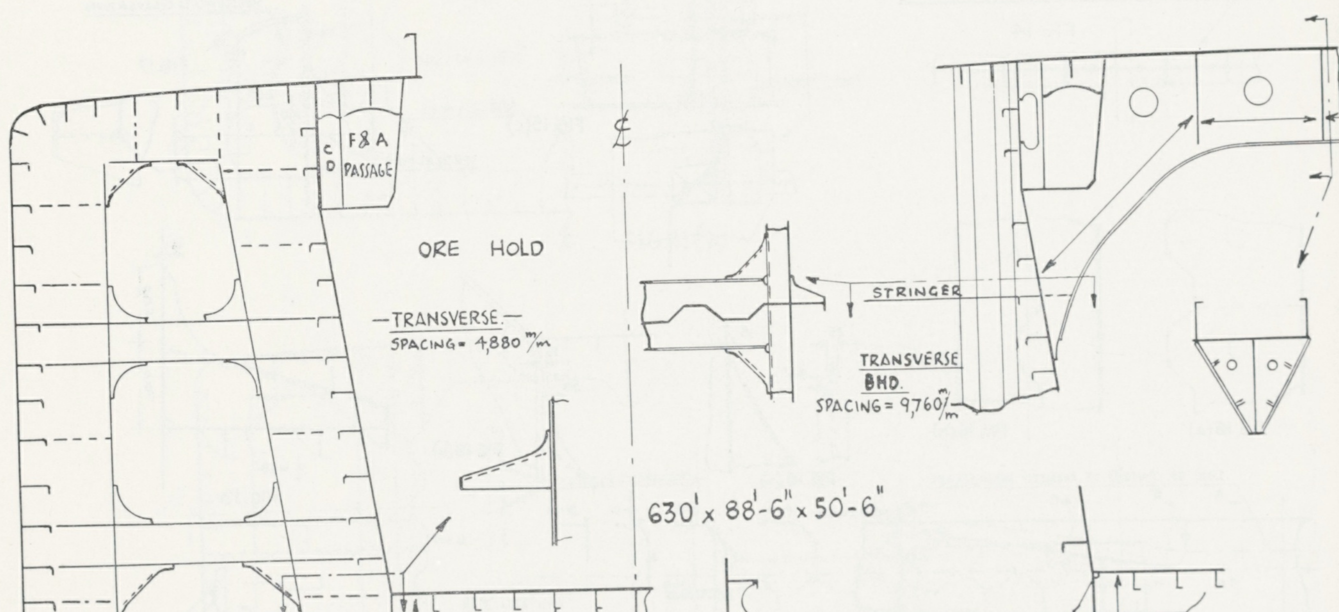

C
D
F & A
PASSAGE
ORE HOLD
TRANSVERSE.
SPACING = 4,880 m/m
STRINGER
TRANSVERSE
BHD.
SPACING = 9,760 m/m
630' x 88'-6" x 50'-6"
INTERMEDIATE BOTTOM
TRANSVERSE

FIG. 23

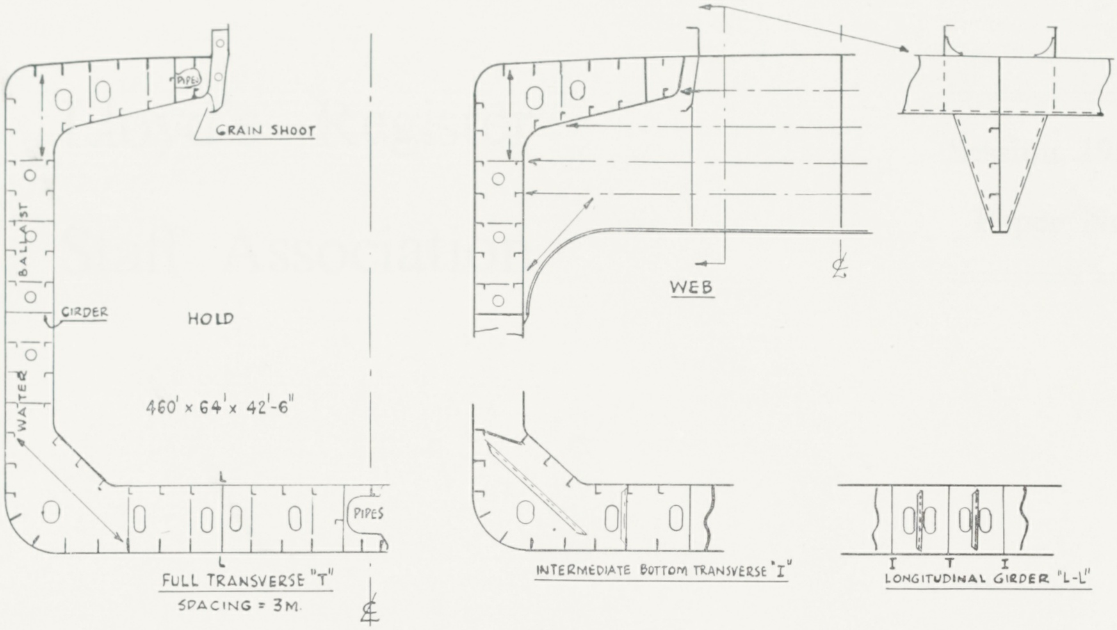
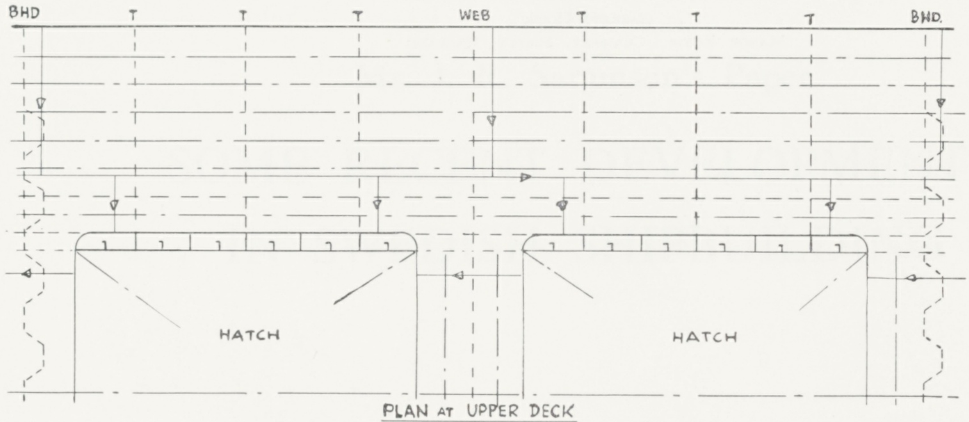


FIG 24



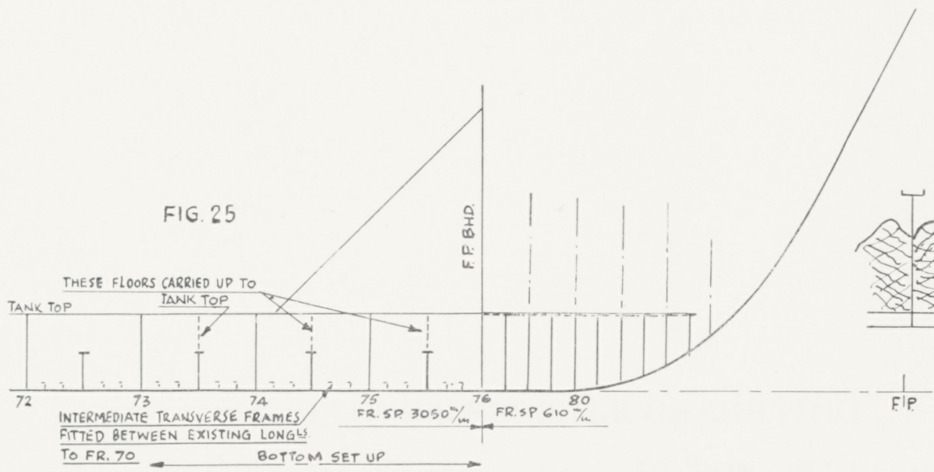


FIG. 25

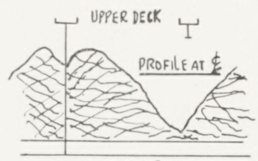


FIG. 26

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Manor Royal, Crawley, Sussex, England

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Session 1958-59

Paper No. 1

Discussion

on

Mr. J. R. Sarginson's Paper

SOME RECENT DEVELOPMENTS IN SWEDISH SHIPBUILDING

LLOYD'S REGISTER OF SHIPPING

71, Fenchurch Street, LONDON, E.C.3

Any opinions expressed and statements made in this discussion are those of the individuals.

Discussion on

Mr. J. R. Sarginson's Paper

Some Recent Developments in Swedish Shipbuilding

MEETING IN LONDON
21st OCTOBER, 1958

(Editor's Note.—Owing to the sudden death of the Author the paper was presented by Mr. J. B. Davies)

Mr. G. BUCHANAN

The Author has given us a very detailed account of the work carried on in Sweden, a country which has been in the forefront of advances in ship design and construction for a considerable time.

They, however, seem to be far luckier in their standard series of tankers mentioned on page 2 than the corresponding builder in other countries. There have been several attempts to standardise construction of tankers in this country, an arrangement with which the Society is in favour, but each owner seems to have his own ideas of dimensions and constructional details and the position at present appears to be that they agree with standardisation in principle provided their own design is used as the standard.

There is one point which should be made clear as regards Table 2. The ballast stresses given in the table are based on the load line section modulus and are for comparison only. They are not necessarily within the allowable limits and therefore should not be considered acceptable. The Author makes this clear in the text but it requires emphasis. If readers are interested in allowable stresses in the ballast condition for ships with machinery aft, they may be interested to know that the Society's allowable stresses will shortly be published.

Whilst we are on the subject of ballast stresses, the Author gives the maximum still water stress in the ballast condition in "paragraph boats" as 4 tons per sq. in. This appears rather a high figure for a 200 ft. ship but the future service of these ships will be watched and it may well be that this figure will be acceptable.

On the question of Swedish practice in tanker construction, the most interesting is the evolution of the present arrangements of the corrugated bulkheads. There is no doubt that the original design led to a considerable amount of trouble due to the flexibility of the transverse and longitudinal bulkheads and it has been necessary to stiffen vertically a considerable number of these bulkheads.

It should be noted that in Fig. 10 (b) the flat portion of the longitudinal bulkhead coincides with the flat portion of the transverse bulkhead, and the sloping portions of each bulkhead also coincide. We recently saw a model of the cruciform section of this arrangement and it was noticeable how flexible this was vertically. As against this a model was also made of the Danish practice where the flat portion of one bulkhead coincides with the sloping portion of the other. It was remarkable how much this increased the rigidity of the junction of the transverse and longitudinal bulkhead when a vertical load was applied.

The latest arrangement where the transverse webs are symmetrical on each side of the longitudinal bulkhead is much preferable to the previous system of unsymmetrical web.

The question has recently been raised as to the maximum length of ship in which corrugated bulkheads could be fitted. Needless to say the enquiry came from Swedish shipbuilders. In these very big tankers over 700 ft. in length, the Society has required that the longitudinal bulkhead should be a plane bulkhead longitudinally stiffened and thus contributing materially to the longitudinal strength. The transverse bulkheads should also be plane bulkheads. It has, however, been agreed that for tankers up to 700 ft. in length the bulkheads may be corrugated horizontally if the webs are symmetrical on each side of the bulkheads. This has actually been agreed to on a 703 ft. ship proposed to be built in Sweden. Only service experience will show whether this is the maximum size of tanker in which this design can be incorporated but in tankers of this size it would appear to be in the best interest to hasten slowly and to put a limit on this type of construction until such time as it is proved satisfactory.

The slab type of longitudinal, which the Author discusses at some length and which was first introduced in Sweden, give a very satisfactory arrangement where continuous bottom longitudinals are called for and should be encouraged. It is a comparatively simple matter to butt weld these slab longitudinals clear of the transverse bulkhead and to carry the longitudinals continuous through the bulkhead. It is also easy to arrange for compensation for drain holes at the after end of the tank space by increasing the thickness or depth of the slab locally as shown in Fig. 13 (b).

Another innovation from the Swedish yards is the rounded sheerstrake shown in Fig. 20. This has now spread to most other countries except the U.S.A. It is an arrangement with a great deal to recommend it and would appear to be the most satisfactory design for the all-welded tanker, incorporating XNT strakes. It may be of interest to know that a portion of a rounded sheerstrake plate has been investigated at Crawley and no adverse effect on the mechanical properties of the plate could be found.

With regard to the ore carrier designs shown in Figs. 22 and 23, these are the standard design for a heavy ore carrier with petroleum carried in the wings on the return voyage. For lighter cargoes the longitudinal bulkheads were moved out towards the ship's side, and although the tanker draught could not be assigned, a decision had to be taken as to the limits of the hold space necessary for the assignment of the ore carrier class. It was decided that provided the sectional area of the ore hold did not exceed $\cdot 7B \times D$, the ore carrier class could be assigned, provided two longitudinal bulkheads were fitted. A design with topside tanks and hopper side tanks may have the sectional area less than the above limit and yet will not be eligible for the ore carrier class due to the omission of the longitudinal bulkheads.

Where, however, a ship of this design, which is quite normal for a bulk carrier, has a section modulus equivalent to that required for the ore carrier, it has been agreed that a notation, "The strength is equivalent to that required for an ore carrier class" can be made on the classification certificate, even though, due to the omission of the longitudinal bulkheads, the ore carrier class cannot be assigned.

Other ships of this type have been assigned a notation "Suitable for carrying ore in Nos. 1, 3, 5 and 7 holds with Nos. 2, 4 and 6 holds empty", but additional web frames and plate bottom longitudinals require to be fitted to obtain this notation.

The Author has given us an excellent paper on Swedish shipbuilding and has not hesitated to underline the teething troubles found in the various designs for which the thanks of his colleagues are due to him.

Mr. W. H. MARSDEN

This paper, with its varied topics, will, I am sure, attract the keen interest it deserves. My attention is particularly attracted to the mention of open shelter deck vessels and the sketches of several ingenious designs for satisfying the tonnage regulations regarding the closing appliances to be fitted to openings in decks and bulkheads of this class of ship.

The requirements governing the fitting of temporary closing appliances to tonnage openings to comply with the tonnage regulations are the direct concern of the National Authority of the country in which the vessel will be registered. The general principles that enable these closing appliances to be considered as temporary are that:—

(1) The arrangement is not readily converted to a permanent closing appliance.

(2) There are no cleats, stud bolts, hinges attached to, nor bolts or holes in, the bulkhead or deck at the edge of tonnage openings.

(3) No battening, caulking, or gaskets of any material permitted.

I would like to refer to the Figs. 2 (a) and 2 (b) on page 14 and consider these under the published British and U.S. tonnage regulations as temporary means of closing with, of course, packing removed. Fig. 2 (a) may not be accepted under British Regulations as they do not permit any type of bolt fastening at shelter deck tonnage opening; present regulations permit only hemp lashings fastened from below cover. The U.S. Regulations, whilst allowing a standard hook bolt, spaced not less than 18 in. apart, in such positions, may consider the arrangement too readily convertible to permanent means of closing. Fig. 2 (b) is not acceptable under the U.S. Regulations, as steel plates are not considered as temporary means of closing to tonnage openings in shelter 'tween bulkheads, only arrangements of shifting boards are permitted in these positions. The British Regulations, whilst accepting steel plates for such positions, in conjunction with the standard hook bolt, may consider the arrangement too readily convertible to permanent means of closing due to the presence of the reversible piece and the design lending itself too readily to making the closing appliance watertight.

I would now like to refer to the first paragraph of the second column on page 3, in which it describes the "paragraph boat of under 500 tons". Mention is made of the recent designs having large depth of double bottom which, generally speaking, would be exempt from tonnage, as tonnage depths are measured to the tank top. It should be noted, however, that certain countries restrict the depth of double bottom which can be exempted from tonnage measurement. This restricted depth depends upon the tonnage length of the vessel and, very approximately, is equal to about $1\frac{1}{2}$ times the Society's Rule depth. A similar restriction is also placed, for tonnage purposes, on the acceptable depth of normal frame, and this should be considered when referring to the practice of increasing the depth of alternate hold frames to reduce tonnage measurement.

In conclusion, may I express my appreciation of this very interesting and descriptive paper.

Mr. C. BUCHANAN

I would like to say that I thoroughly enjoyed reading this paper which is one of extreme interest, particularly in the glowing manner in which the salient features have been presented, and not least to colleagues who have not had the opportunity to study the "Continental Outlook".

Great respect must be shown to the Author for the informative manner in which he has presented the development of the Swedish shipbuilding industry during the transitional years.

It is extremely gratifying to note in the Author's opening remarks that in Sweden the shipbuilding technicians are graded highly and remunerated accordingly.

In view of the Author's remarks regarding Plan Approval work in Sweden, it would be interesting to learn whether he considered that the Surveyors' work is one of more than an advising capacity (particularly in view of the competitive nature of the Classification Society's in this country).

Dry Cargo Ships

Regarding the longitudinal framing of double bottom and referring to the several arrangements shown, Fig. 6 has much to commend itself particularly where owners require their Classification Certificate to be endorsed suitable for "Heavy Cargoes" and the resulting design facilitates good continuity of strength in conjunction with fabrication.

Experience Gained from Ships in Service

Whilst it is agreed with the Author that the "Paragraph" type is more prone to heavy weather damage resulting in buckled and set up bottom shell plating forward, and also bearing in mind since the advent of the diesel type of propelling power that ships are more commonly "punished", I still feel that a further contributing factor is this mania for scalloping of floors and frames in an area where, in my opinion, scalloping should not be permitted. As a practical solution, I would suggest complete elimination of scalloping in the pounding area; in association with full height double bottom girders, spaced a maximum of 3 ft. 6 in. and a deep tank fitted forward (if considered necessary) to obtain a satisfactory draught in the ballast conditions.

It is also interesting to note (on page 4) that certain types of beam knees which appear to have been satisfactory in other structural positions, have required reinforcement and alterations in the panting area, and again drawing to our attention the need for greater care to be exercised when approving welded arrangements, subject to "live stresses".

In view of the recurring troubles with certain scalloped connections referred to by the Author and also borne out from records in this office, would it not be prudent to have the rules amended accordingly?

Oil Tankers

This section dealing with the post-war history of the Swedish tanker designs is particularly well dealt with and the resultant basic design as illustrated in Fig. 10 (f) to my mind is extremely good.

However, I would prefer to see two wing tank struts fitted for the same reasons as the Author (page 5, para. 5) and whilst the "softened" tripping brackets are admirable, these in my opinion should be fitted in association with end pads—suitably tapered similar to the riveted type "T" bar.

Variation of Design

Several of the features of Figs. 11 (a) and 11 (c) are in accordance with good tanker design and practice, particularly the cross tie and horizontal stringers in association with vertical webs and also the introduction of plane longitudinal bulkheads in the vicinity of the deck and shell.

Personally, I would prefer to see the plane plates extended beyond the toes of the centre tank bottom and deck transverses, as the arrangement (and similar types) as detailed in Fig. 18 (b) are often subject to misalignment.

Details such as these are no credit to the design staff and are a source of annoyance to shipyard managers and surveyors.

Mr. W. S. RICHARDSON

My comments on this excellent paper are very few and mainly confined to the exploratory type, seeking more information.

To what extent do Swedish builders adopt new advances in design or advances in research, as compared with British shipbuilders? For example, on page 5 the Author discusses a series of ships, and from reading this it would appear that the British technique was confined to the old idea of "when in doubt, double the thickness". Perhaps some investigation has been carried out from the point of view of stress distribution, for the production of more efficient structures. In this country, for example, B.S.R.A. intermittently produce reports on ships and bits of ships which are, presumably, acted upon.

Page 2, 11th line from the bottom of the first column: here are mentioned conflicting problems of hog and trim in the ballast condition being readily overcome. I stand very much open to correction on this, but should this not read "are not readily overcome"? To fit either a deep double bottom or ballast tanks amidships to reduce the stress would appear to be a rather unhappy way of dealing with the problem.

On page 3 I see the methods employed to reduce the tonnage of the paragraph type of ship. For those who may have to do Safety Equipment Surveys, I would point out that a vessel less than 500 tons gross does not necessarily have to comply with the present International Convention for the Safety of Life at Sea.

On page 3 at the bottom of the page, reverting to Mr. C. Buchanan's remarks about the damage in the bottom forward, the Author remarks that it may probably be due to the force with which the ships are driven through the sea when light. Is that due to the Master or the Officer in charge or is this damage peculiar to Swedish shipbuilding? Or, again, is this trouble experienced elsewhere?

On the subject of fractures, it would be interesting to know whether the fractures were brittle, caused by bad design or excess tension, etc.

Lastly, a little point about tankers with no midships structures. From the point of view of safety when these ships comply with the Convention, lifeboats are to be supplied. In my opinion, when this Convention comes up in a couple of years time or so, the question of inflatable life rafts will be discussed, and lifeboats, as such, may not have to be carried as they are in the present arrangement.

Mr. J. FRIZE

The Society and, judging from the paper, Sweden, have lost an excellent ambassador. This, the Author's last survey commands the highest tribute.

The design shown in Fig. 8 is indeed of unusual interest. A more normal arrangement would provide access to the wing refrigerated chambers via cargo doors in the 'tween deck longitudinal bulkhead. Assuming the necessity of outboard hatches, it would appear that the second deck could have, to advantage, been made a rule deck (instead of stringer and tie arrangement), thereby easing the task of finding the strength deck area. Perhaps the mentioned influence of ship management on design has led to this apparent example of cargo handling assuming importance over hull strength.

Corrugated bulkheads are obviously a partiality of the Swedes. This is not generally shared since, for example, a number of British yards have not adopted the system while some of the largest tanker companies are rather averse. The Society makes but scant reference to them in the Rules—which may or may not be of significance! (The disclosure has been made in the discussion of proposed limitation of their use in the largest tankers to the Society's class.) Further emphasis is supplied by the Author's impartial record of troubles experienced with, or due to, bulkheads being of corrugated form. His opinion on this would have been valuable.

The symmetrical vertical web shown in Fig. 16 (b) poses the dilemma of having the longitudinal bulkhead desirably made the continuous member, with the possibility of malalignment of the web, or the sacrifice of bulkhead continuity for the web.

A similar problem is whether to make the bottom centre girder continuous or intercostal, and it is of interest to note that in Sweden the continuous girder is employed. Again this practice is not universal when $B \times D$ product is less than about 4,000. Could this be considered a safe upper limit for an intercostal bottom girder?

Scalloping of stiffening members, as adopted extensively in Sweden, appears elsewhere to be falling into disuse—particularly in large tankers. Is this of significance?

Rivers in this country set up geographical kinship and rivalry among shipbuilders. Fig. 1 prompts the query, how intense is local partisanship in Sweden?

Mr. G. M. BOYD

Referring to page 3, on the matter of pounding, I would like to ask whether the practice for stiffening the bottom forward is different in Sweden from that in other countries. Some years ago, we did an investigation on this and found that, at that time, by the rather rudimentary methods then available, the Swedish method of stiffening had a better record. I think it might be worth while to bring this investigation up to date. Arising out of that investigation, we suggested that B.R.S.A. might set up a Committee to look into the causes of slamming and this was done, but I think the investigation languished. This seems a pity, as it would clearly be better to eliminate the causes rather than provide stiffening against it.

This paper is a particularly valuable collection of troubles and the methods which have been proposed and adopted for overcoming them. It provides several valuable lessons that should be taken to heart.

We are frequently criticised that we do not, as a Society, give out more information of this kind, gained from our experience and knowledge, and this seems to me the kind of paper that would be worthy of a wider circulation than to the Staff Association. This might be considered by the Committee.

The only other point I wish to make may seem rather frivolous, but it has a more serious side:—

Mr. Burton Davies in his opening remarks, did not mention welding at low temperatures, which must be a matter of importance in Sweden.

Recently, there was a visit to this country by Professor Rykelin from the Soviet Union, during which he addressed a meeting of the Institute of Welding. I was interested to find out about welding at low temperatures in Russia, and when I put the question to him his reply was very revealing. He said, in effect: "I think there was a regulation once about the minimum temperature, but I think it has fallen into disuse, and now, if there is a limit at all, it is below $-40°$ C." He then went on to say that the principle adopted was not so much to pre-heat the work in hand as to pre-heat the welder. If the welder was warm enough to work then the weather was suitable for welding!

I had not the pleasure of knowing Mr. Sarginson, but judging from this paper, I think he is a very great loss to the Society.

Mr. T. A. LAMPLOUGH

This is a very short addition to the discussion.

I would like to bring your attention to the paragraph on page 1 which says: "A shipyard of any standing has a large and highly skilled technical staff both indoor and outdoor".

I believe that in Sweden the heads of most yards are technical men, so that new ideas in construction and design are readily accepted and put into practice quickly, if suitable.

Yards in Sweden have men employed solely on design improvement and two ideas which have been widely adopted for their merit are the use of slab longitudinals in large tankers and the rounded gunwale arrangement.

The Author states categorically that "the technical staff are the most important and most highly paid in the Swedish yards". From the body of the paper it would appear that Swedish shipyards in general are up to date in their outlook and methods, this point being emphasised by a pertinent remark by the Author who said "riveting is generally regarded as a retrograde step by shipbuilders and some owners".

I believe, therefore, that the results of having technical men in general control of shipyards in Sweden have proved the wisdom of such a policy.

WRITTEN CONTRIBUTIONS

Mr. N. FLENSBURG (Gothenburg)

Mr. Sarginson has given a very lucid picture of the recent developments in shipbuilding in Sweden. A comparison between his paper and a similar paper given to the Staff Association about ten years ago by Mr. H. J. Adams shows the radical change in the general design of ships built in this country as well as of their detail design. Mr. S. Townshend's words on the discussion to Mr. Adams' paper are valid also for the present paper, and I take the liberty to quote as follows: "His contribution represents an immense amount of work not only in preparing the numerous interesting and useful sketches but also in collating much information and many divergent practices into one paper and he has covered his ground very thoroughly".

It has been my privilege to have worked with Mr. Sarginson in the Gothenburg Plans Department for so long a time as seven years and always noticed his ability to arrive quickly at the basis of any subject under consideration, which faculty is well demonstrated in this paper. His sudden loss last summer came as a shock and it must be recorded that his colleagues, as well as his many friends in the Swedish shipbuilding industry, miss the friendly advice which he was always so willing to give.

Only a few comments will be made on Mr. Sarginson's paper.

Regarding the map showing the Swedish shipyards a few additions could be made. Messrs. Oresundsvarvet's third berth is not yet extended to its full length to take 80,000 tons deadweight tankers, but has such a breadth as to take two ships of about 6,000 tons deadweight side by side at the same time. Messrs. Kockums are at present enlarging one of their berths to a capacity of 90,000 tons deadweight.

On page 2 it is mentioned that one yard has patented a shelter deck tonnage opening that can be used when the ship is in open or closed condition. The National Authorities had at first no objection to a steel cover plate being fitted for the open condition, but this was subsequently altered by the Authorities who decided (before the ship in question was delivered) that ordinary wood covers must be fitted instead. It should be made clear that although a bolted steel plate cover with watertight packing is accepted for the closed condition by the Swedish Authorities, it is not now accepted by the Society.

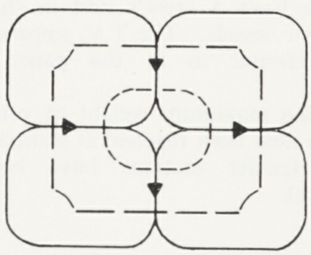
As will be seen from the paper, the Swedish yards are generally very keen to have corrugated bulkheads in their tankers. This type of bulkhead has been approved for tankers up to a length of 670 ft. (40,000 tons deadweight). In larger tankers the longitudinal bulkheads are made plane, but there has recently been proposals from one yard which builds tankers, having horizontally corrugated longitudinal and transverse bulkheads, to adopt this system also for their 48,000 tons deadweight tankers. The longitudinal and transverse corrugated bulkheads will have "pillar" support in the form of symmetrical webs. These builders have ten smaller ships (Fig. 10 (f)) to L.R. class, as well as about the same number of varying sizes classed elsewhere, in service with this design, which it is claimed have so far sustained no fractures in the bulkheads. There seems to be some justification to accept the builders proposal, if the shear forces on the ship section is satisfactory. Model experiments with plane and horizontal corrugated bulkheads show that the corrugated bulkheads can take certain shear forces if the span of corrugation is not too great.

Referring to Table 3, Bulk Carriers, it could be mentioned that a few ships of this type have recently been dealt with in which the transverse hold area has not been restricted in order to obtain the "ore carrier" notation. For these ships, which are not intended to carry ore as a usual cargo, a section modulus less than 18 per cent in excess of that required by the Load Line Convention has been accepted. In one case 13 per cent was accepted.

Mr. B. GRAUERS (Gothenburg)

This is a most interesting paper which our late colleague J. R. Sarginson has given us. He has given a clear picture of the problems and achievements of Swedish shipbuilding during and after the second world war.

During the war many novel designs were evolved and many of them submitted for approval for minimum scantlings. New ideas were embarked upon with only scant knowledge of the effect of substituting welding for riveting and the problem of notch brittleness of steel was little understood. Scarcity of materials cut down owners extras to nearly zero and many improvisations had to be adopted to save steel. For instance intercostal brackets in side girders in double bottoms were sometimes built up of four punched pieces cut from manholes as shown:—



Profiles were also saved by flush-welding pieces from cuts from other bars thus giving new profile bars, etc.

Some odd things, however, had to be paid attention to. As regards longitudinal framing in double bottoms of cargo vessels the rules permitted solid floors on every fourth frame with brackets on every frame at the margin plate (three off) and two brackets at the centre line where instead extra docking stiffening or bracketing should have been fitted. Buckling was thus caused at dockings.

The beam knees shown in Figs. 4 (a) and 4 (b) were also a war-time product. The disadvantage of these has been clearly shown in later experience. This type of bracket is not used any longer.

Regarding tankers and the webs on the transverse bulkheads it might be pointed out that only one web was fitted in the centreline in the first vessels of this type which has also been mentioned in the paper in Fig. 10 (b). In later vessels the builders made it a standard that two similar side webs were being fitted on account of the large span of the stiffening. Due to the large surface of these webs they acted as wash bulkheads and had to be reinforced. As a stiffening and repair measure cross-ties were arranged between all three webs but this was not proved entirely satisfactory. The alternative arrangement of additional horizontal stiffeners in way of tripping brackets shown in Fig. 10 (d) also resulted in difficulties as the stiffeners tended to crack.

Due to the cold flanging of the knuckles of the bulkhead plating the builders thought that no welding should be carried out in this area and the tripping brackets were fitted 1 in. away from the knuckles and of course this caused fractures in the bulkhead. It was on this vessel that the first horizontal stiffeners were fitted as described in Fig. 10 (d) and it was a repair measure.

It has to be mentioned that one owner proposed to remove the side webs on the transverse bulkheads in order to save weight; as it was found that measures taken to reduce trouble, such as extra longitudinal bulkhead webs, stiffening of side webs in side tanks (10 (c)) and stiffening of corners between longitudinal and transverse bulkheads (10 (c)) caused a loss of some 100 tons in deadweight.

The advantage to have all accommodation aft on tankers and ore carriers referred to in the third paragraph on page 8 in the paper may be discussed both from the point of view of navigating the vessel in fog and from the point of handling the lifeboats. The Swedish authorities find it most desirable to have a crow's nest in the forward mast on such vessels. The T.V. apparatus in the foremast referred to in the paper was not installed.

Finally, the maximum weight of prefabricated sections has now been reached at something about 40 tons. Heavier sections have been found uneconomical.

Mr. R. J. HOOK (London)

In connection with the reference on page 3 to the shortage of deck and engineer officers in the Swedish Merchant Navy and the introduction of "school ships" it might perhaps be of interest to note that to meet a similar problem a leading British Shipping Company have had a vessel built to accommodate 70 cadets, 30 of whom are engineer cadets. It is the first British ship to be specially fitted out for the training of marine engineering cadets and has mechanical, electrical and heat engine laboratories in addition to workshops and lecture rooms. The vessel will operate on the U.K.—Australia—New Zealand refrigerated cargo trade.

Mr. C. LLOYD ROBERTS (London)

First impressions of this interesting and informative paper are that it suggests that the Swedish shipbuilding industry by its modern methods is ahead of most other countries.

However, reading between the lines one realises that it has developed its present practice by the old fashioned method of "trial and error" and that this process is still being to a lesser extent pursued in conjunction with the findings of the fortunate highly paid experts whose employment is certainly a great step forward from all points of view.

The Author states in paragraph 6 on page 1, that plan approval work in Sweden is different from other countries, but he has in reality only set out a few of the reasons for the existence of this Society, and it is suggested that most of this reference is common to the duties of all the Society's Surveyors, wherever they may be stationed.

Referring to page 1, paragraph 8. As it is stated that it is not unusual to prefabricate parts of the structure at sub-contractors workshops not shipyards, it would be of interest to know if these establishments carry out the work under survey so that the quality of workmanship and materials is up to the standard required by the Society, as if so, it seems difficult to understand why the various mistakes referred to were not corrected before despatch.

In this country the supervision of sub-contract work is usually covered by the Surveyors' Certificate on Report 10, and it is customary to charge a separate fee for the services of the Surveyor.

REPLY BY MR. J. B. DAVIES

At the request of the Committee of the Staff Association I will endeavour to reply to the factual points raised but contributors will, no doubt, appreciate that I cannot deal with those points where their remarks are more a matter of difference in opinion.

Mr. G. Buchanan's remarks are valuable as amplifying several points mentioned in the paper and do not call for any reply from me.

Mr. Marsden comments on the closing appliances shown in Figs. 2 (a) and 2 (b) and, as he will see from Mr. Flensburg's contribution, the Swedish authorities apparently had second thoughts on the matter since wood covers were actually used when the ship left the builders in the "open" shelter deck condition.

In reply to Mr. C. Buchanan I can certainly confirm that Plan Approval Surveyors are expected to do considerably more than is strictly covered by the words "plan approval". Builders (and owners) appreciate advice on alternative proposals from the early design stage and this

advice may well cover items other than classification. After all, we have access to a far greater amount of information and experience than any one builder and the builders and owners appreciate the use that can be made of this source of information. How much this is "more than advisory" is difficult to say since much depends on one's personal relationship with the yard in question and also whether the item under discussion is one when the Surveyor can say "Well, if you do not do this, the Rules will require ·08 on the deck".

Mr. C. Buchanan does not like scalloping in the bottom forward and I agree that this is a matter which requires investigation.

MR. RICHARDSON asks about the application of research in Sweden. A Swedish Shipbuilding Research Foundation was set up some three or four years ago but before that (and still today) several of the larger yards carried out a good deal of research on their own. Perhaps because this is carried out in close association with the drawing office and yard personnel much useful work has been done in this way.

Mr. Richardson is correct regarding the conflicting problems of trim and strength and if this is not investigated in the early design stage difficulties arise when the midship section is submitted.

A lot of the trouble in "overdriving" is probably consequent on the wide-spread use of the diesel engine which can produce its full power in any weather. Similar remarks apply to oil-fired boilers. With the old coal-fired boilers the fireman simply could not shovel sufficient coal to drive the ship in heavy weather.

MR. FRIZE remarks that the design shown in Fig. 8 shows the influence of ship management on design but surely all ship design must show this influence. In the present design a standard of strength fully up to Rule was obtained by incorporating the heavy continuous longitudinal bulkheads. Access to the refrigerated chambers through doors in the longitudinal bulkheads was ruled out by the desire to be able to work both refrigerated and general cargo at the same time.

In tankers the bottom centre girder should, in general, be continuous when the length is much over 500 ft. Scalloping may well be going out of popularity due to the increasing use of automatic welding.

Local rivalry certainly exists in Sweden, even between two yards in the same district.

MR. BOYD also raises the question of pounding damage and it might well be a help to bring the investigation he mentions up to date. With regard to his remarks on welding in Russia I would not like to be the welder trying to work at –40° C., perhaps –10° C. represents a reasonable minimum but much depends on the conditions.

MESSRS. FLENSBURG and GRAUERS have added much useful information to the paper and I would thank Mr. Flensburg for clearing up the point regarding the tonnage hatch. Mr. Grauers' remarks on the optimum size of units are particularly valuable in view of his long experience in a yard which has been one of the foremost exponents in prefabrication.

MR. LLOYD-ROBERTS can be assured that all sub-contracted work is carried out under survey but I regret I cannot add anything to the Author's remarks on this practice.

In conclusion I would like, as a colleague and friend of Mr. Sarginson for many years, to associate myself with the tributes which have been paid to his work.

Printed by Lloyd's Register of Shipping
at Garrett House
Manor Royal, Crawley, Sussex, England

For Private Circulation amongst the Staff only

Lloyd's Register Staff Association

Session 1958 - 59

Paper No. 2

TONNAGE

by

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LLOYD'S REGISTER OF SHIPPING

71, Fenchurch Street, LONDON, E.C.3

The Authors of this paper retain the right of subsequent publication, subject to the sanction of the Committee of Lloyd's Register of Shipping. Any opinions expressed and statements made in this paper and in the subsequent discussion are those of the individuals.

Tonnage

by R. Gray & L. Beckwith

INTRODUCTION

The Authors have both spent over two years on the computation of tonnages and the examination of related plans in the Freeboard Department in London office. During this time they have noted many of the difficulties encountered by some of their colleagues in measuring vessels for tonnage, and therefore felt that a paper such as the following would help to iron out some of these difficulties, whilst at the same time creating an opportunity for the discussion of many other aspects of the work which may not have been covered by it. The Authors would emphasise that they do not consider themselves to be "tonnage experts", but, in presenting this paper, hope to impart some of the knowledge, gained during their experience of this subject, to those colleagues who have it to contend with amongst the many other day-to-day jobs, and others who may be meeting it for the first time.

HISTORICAL

Before considering the actual tonnage admeasurement of a vessel, it may be as well, initially, to understand exactly what is meant by the terms "Gross" and "Net" Register tonnage and the reason why the system of measurement, as employed today, came into being.

First, it must be understood that the terms "Gross" and "Net" Register tonnage are arbitrary measures of no value in the actual working of the ship, since, although having a general relationship to the actual size of a vessel, they do not express the capacity of the holds or the amount of cargo that the vessel can carry. Neither one is a concrete and factual figure such as "Displacement" and "Deadweight" tonnage. The present practice is to use the terms "Displacement" and "Deadweight" tons as expressions of weight, each ton being of weight 2,240 lbs. "Gross" and "Net" tonnages are not measures of weight, but are volumetric units of 100 cubic feet, and as such, are wholly empirical yard-sticks for purposes of taxation. Upon one or other of these two tonnages will be levied, at some tariff rate per ton, the dues and charges for the use of harbours, canals, wharves, drydocks and similar facilities throughout the life of the vessel, hence it is highly desirable that a vessel's register tonnages should be as small as is consonant with the service for which it is intended.

To see how the present-day system of tonnage admeasurement came about, however, it is necessary to go back into English history.

The earliest definite record of a specific expression for carrying capacity of vessels occurred about the thirteenth century, in connection with vessels for the carrying of wine, and by the fifteenth century, wine barrels in England, by decree, arrived at a definite capacity and the law prohibited casks or tuns of less than 252 gallons. At first the taxes and port dues were paid in actual barrels of wine and were called "prisage". It amounted to one barrel, or tun, up to 20 and two tuns over 20. Eventually taxes were levied on other cargoes and were based upon the number of tuns the vessel could carry. This made necessary a means for determining that figure when the vessel was loaded with commodities other than barrels of wine. As would be expected, the carrying capacity of vessels came to be known as "Tunnage" and, at some transition period, the corresponding words "ton" and "tonnage" were adopted.

Initially, the tonnage of vessels was estimated by multiplying the length of keel by beam by depth of hold and dividing the product by 100. Subsequently, because of the difficulty of measuring the depth of hold of a loaded vessel, depth was taken to be half the beam and the tonnage formula became: —

$$\text{Tonnage} = \frac{L \times B \times B/2}{100}$$

The divisor of 100 was later changed to 94, and this formula, known as the "Builders Old Measurement Rule", was adopted by Parliament in 1720. The difficulty, however, of measuring the length of hull of a vessel afloat led to a further modification. Length of hull was arbitrarily assumed to be extreme over-all length of the vessel less three-fifths of the beam. In 1773, the formula thus became: —

$$\text{Tonnage} = \frac{(L - \frac{3}{5}B) \times B \times B/2}{94}$$

It will be noted that now the taxable dimensions were those of length and beam with no penalty on depth or draught. Vessels hence became narrow and deep and unsafe. Serious losses could be directly attributed to this rule and in 1821, 1833 and 1849 respectively, Royal Commissions were appointed to study the whole situation and propose improvements. None of these Commissions, however, produced a satisfactory answer.

In 1853, George Moorson, Secretary of the 1849 Commission, proposed a new system of measurement known by his name.

He proposed to measure the entire internal cubic capacity of the vessel, using Simpson's Rules, and so arrive at a gross tonnage expressed in

cubic feet. From this gross tonnage, he further proposed to deduct certain non-paying spaces, such as sail locker, machinery space and bunkers, to arrive at a measure of the space available for cargo. In order to keep the tonnages derived by his system in line with existing tonnages, he proposed to adjust his measured capacity by some constant so that the average net tonnage under his proposed new rules would approximate that under the old. By experiment, he found this constant to be 98·22 but, for simplicity, adopted 100, which is why gross and net tons are of volumetric units of 100 cubic feet. It will be seen that, of the two tonnages, gross was generally a measure of total size of vessel, whilst net tonnage, initially at least, bore a relation to its earning capacity or ability to pay. The "Moorson System" was adopted and incorporated in the "Merchant Shipping Act" of 1854, and its theory was subsequently adopted more or less intact by all other maritime states, and is still basically in effect today, although, as would be expected, additions and amendments have been made, from time to time, by different countries, to meet changed conditions, and in some cases have a profound effect on the final tonnages, e.g., the American Tonnage Regulations exempt all water ballast spaces, whilst the British Tonnage Regulations allow such spaces as a deduction up to a limit based on the gross tonnage.

Attempts have been made during the past years, to try and formulate one system of tonnage measurement which would be acceptable to all maritime nations, but although progress in this direction has been made, the actual application of such a universal acceptable system of tonnage measurement has still not been adopted. Circumstances being such, it is now proposed to proceed to the main theme of this Paper, i.e., "Tonnage Admeasurement of Vessels, as in accordance with Part 2 of the U.S. Customs Regulations of 1943".

GENERAL NOTES

The Society is authorised to issue tonnage certificates to Liberian, Panamanian, and Nicaraguan vessels, which countries have adopted the United States Tonnage Regulations as being their system of admeasurement.

If authorised to do so, the Society can issue tonnage certificates or statements of tonnage admeasurement to vessels of other countries and, in fact, have done so. In nearly all these cases the tonnage regulations to which the vessel in question had to be measured was the British Tonnage Regulations.

It is of interest to note that most of the European countries carry out their tonnage measurements in accordance with the so-called International Tonnage Regulations. These regulations were formulated by the tonnage section of the League of Nations in 1939 and adopted by the signatories of the Oslo Convention in 1947. Up to the present, the Society has not carried out any tonnage measurements in accordance with these regulations and it is not proposed to discuss them in this paper.

The Society is sometimes asked to measure vessels for the issue of a Suez Canal Special Tonnage Certificate and a Panama Canal Tonnage Certificate at the same time as measuring the vessel for a national tonnage certificate. In such cases, it is usual for guidance to be sought from London office before proceeding.

The majority of tonnage measurements which are most likely to be met with in practice will be in accordance with the U.S. Tonnage Regulations, i.e., "Measurement of Vessels", Part 2 of the Customs Regulations of 1943. These regulations are self-explanatory as to how the tonnage admeasurement should be carried out and ideally the object would be for each Surveyor to have his own personal copy for reference. Unfortunately, due to various circumstances, this is not possible and the main purpose of the following paper is to outline as simply as possible the system of tonnage admeasurement adopted by these regulations and in some cases, where thought necessary, to enlarge on the actual ruling given by them so as to reduce to the minimum any controversy which may arise as to the exact interpretation of these regulations.

The Authors would emphasise that, in many instances, the methods set out in this paper are the present practice prevailing in London office and may not necessarily be the official interpretation of the authority whose tonnage regulations are being used. Decisions quoted may not be valid at some future date as the whole system of tonnage measurement is fluid and is continually under review by the various bodies connected with it.

Although this paper is devoted primarily to the system of admeasurement as outlined in the U.S. Tonnage Regulations, since at some time or other Surveyors will probably have to admeasure vessels in accordance with the British Tonnage Regulations, attention has been drawn to the differences which exist between these two sets of regulations. On the whole, the actual system of admeasurement as outlined for the U.S. Tonnage Regulations also applies to the British Tonnage Regulations, the difference being with regard to certain lengths and treatment of certain spaces with respect to division into parts, exemptions and deductions.

Before proceeding with the actual method as to the tonnage admeasurement of a vessel, it is thought that the following notes may be of assistance to those colleagues who are unfamiliar with this type of work.

1. Before undertaking the tonnage admeasurement of a vessel, application in writing for the tonnage measurement of the vessel should be received from the builder, owner, or owner's representative.

In cases where the Society is requested to issue tonnage certificates for ships to be registered in countries other than Liberia, Panama and Nicaragua, it is advisable to seek guidance from London office before proceeding.

2. All measurements are taken in feet and fractions of feet, and all fractions of feet expressed in decimals.

3. The builder of a vessel of over 100 gross tons, approximately, is usually requested, in order to facilitate measurement, to supply at a reasonable time before the measurement is commenced, the following plans: —

(*a*) A drawing of the amidship section showing the construction of the double bottom.

(*b*) A drawing of the inboard view of the longitudinal section showing the double bottom, its use or uses, if existing, otherwise floors, the compartments for water ballast, other than the double bottom, the decks, superstructures, hatchways, etc.

(*c*) Deck plans showing the arrangement and uses of different compartments.

(*d*) Drawings showing the arrangement of the machinery spaces, including boiler and fuel compartments.

(*e*) A tonnage plan showing half breadths of the transverse sections at the points of division of the tonnage length of the vessel into the number of equal parts in accordance with the rules (given later in Table I) for the measurement of spaces under the tonnage deck.

(*f*) Drawing or sketches showing the temporary closing appliances of tonnage openings leading to open spaces.

4. If a request for measurement is received in good time, it is advisable to begin as soon as the vessel is sufficiently advanced in construction, i.e., when the decks are laid, the holds cleared of encumbrances and before the machinery is installed and accommodations are partitioned off.

5. The instruments to be used for taking measurements as laid down by the regulations are (a) a waterproof tape, graduated in feet and tenths of a foot, and as nearly inelastic as possible; (b) graduated sliding rods of sufficient size to enable the greatest depth to be encountered in the measurement to be taken.

6. All measurements should be recorded on the tonnage formula forms T 1 and T 2.

On receipt of an application for tonnage measurement, if the vessel to be measured is of unusual construction or if there is any doubt as to how to proceed with the actual measurement, it is usual to seek guidance from London office and forward a General Arrangement plan showing the profile and decks of the vessel and also a list of all engine room auxiliaries or a separate plan showing them.

On the plans forwarded is marked the method of underdeck measurement to be adopted, the division of the ship into parts as necessary and the number of ordinates required for each part, for the machinery spaces, and for the peak tanks (if fitted exclusively for the carriage of water ballast); the line of floors is also indicated where necessary. The engine room auxiliaries which are to be considered as part of the propelling machinery are also indicated, together with all spaces which are to be exempted or deducted from the gross tonnage measurement as the case may be.

If it is found that time or circumstances do not permit the complete working out of the tonnage computation, the measurements are forwarded to London office and the tonnages worked out there. It is often found that the tonnage figures are urgently required just before the vessel completes and it may be that some of the measurements could not be obtained until this time. If the underdeck measurements on form T 1 are forwarded as soon as completed the underdeck is worked out pending the receipt of the remainder of the measurements. Time is saved in many cases where this is done.

In certain instances photostat copies of completed computations have been sent to Surveyors on request but it was stressed that these were for the Surveyors' information only and that London office should be approached before information on them was disclosed to anyone outside the Society.

DEFINITIONS

STEM:

A vessel's stem is described according to its contour, i.e. straight, raked, curved or square.

STERN:

The stern is described according to its shape at the after end below the upper deck or line of same as round, elliptical, cruiser, transom, etc.

MASTS:

In addition to what are commonly known as masts, spars set up the centre line of the bridging at the top of king-posts of certain vessels for signals and wireless antennæ, etc., are considered as masts.

The number of king-posts and derrick posts, etc., independent of the supported masts should be separately stated after the number of masts, e.g., "Two masts and eight king-posts" or as the case may be.

CEILING, CARGO BATTENS, ETC.

(*a*) Ceiling: Permanent planking, fitted directly on the inboard side of the frames, or floors, or the top of the double bottom is considered to be ceiling. The maximum allowance for it being 3 in. on the bottom and 3 in. on each side.

When it is less than 3 in. thick, the actual thickness is allowed.

Depths and breadths are not decreased due to grounds supporting ceiling nor is any allowance made for ceiling on the under side of deck beams.

(*b*) False ceiling: In small vessels with "false ceiling" in a portion of their cabins, in their holds, or forming a part of their seats or lockers, etc., therein, and which stands off from their frames—that is, not fitted to them as ordinary ceiling—the breadth is taken through the "false ceiling" to the inner faces of the vessel's frames and the thickness of the "false ceiling" is deducted on each side.

If, however, there is a ceiling fitted on the frames in addition to the "false ceiling", the breadths are taken to the ceiling on the frames making no allowance for the "false ceiling".

(*c*) Cargo battens, insulation: Paragraph (*a*) above also applies to cargo battens and insulation.

Register Length: *See* Fig. 1

(*a*) The length measured on the tonnage deck from the fore part of the outer planking (where it is rabbeted) on the side of the stem of wooden vessels, or fore end of lap of outer planking of steel or iron vessels, to the after side of the main sternpost is the register length.

(*b*) In the case of screw vessels with no sternpost, the length is taken to the forward side of the rudder-stock or line of same extended through the deck.

(*c*) The register length of scows and barges, with a square bow and stern sloping up from the bottom to the deck, and with neither stem nor sternposts, is taken on the deck from the extreme point of the hull at the bow to the extreme point of the hull at the stern; in other words, the overall length of the hull, not including guards or rubbing strakes, is the register length of such vessels.

British Rules

(*a*) *The length measured from the* extreme fore side of the stem *to the after side of the main sternpost is the register length.*

(*b*) *In the case of screw vessels with no sternpost or fitted with a balanced rudder, the after terminal of the register length is taken to the* fore side of the rudder trunk *or line of same extended through the deck.*

Register Breadth: *See* Fig. 2

The register breadth is the extreme breadth of vessel measured over the outer skin at or below the upper deck and at the widest part of the hull disregarding rubbers or fenders.

Register Depth: *See* Fig. 2

(*a*) The register depth is taken at the middle of the tonnage length from the underside of the tonnage deck, or line of same, down to the top of the floors at the side of the keelson, the ordinary floor timbers or plates when fitted or to the top of the inner bottom plating of a cellular double bottom, as the case may be in a direction perpendicular to the keel.

British Rules

The register depth is taken at the middle of the register length *from the underside of the tonnage deck, or line of same, down to the top of the floors at the side of the keelson, the ordinary floor timbers or plates when fitted or to the top of the inner bottom plating of a cellular double bottom, as the case may be, in a direction perpendicular to the keel.*

(*b*) If ceiling is fitted on the above-mentioned bottom members the register depth is measured to the top of same and the height of grounds, battens or other type of support for the ceiling is added to the depth obtained.

(*c*) If ceiling is fitted only locally in way of the hatches, then the register depth is measured to the top of the inner bottom plating.

(*d*) If the vessel is measured in parts, as explained later, the register depth is still taken as in (*a*).

Upper Deck to the Hull:

The uppermost complete deck, which extends from stem to stern and from side to side at all points of its length and below which there are no openings through the hull, as required in shelter deck spaces, and also having its hatchways or other openings provided with means for closing them against the action of the sea and weather upon the space below enclosed by the sides of the vessel making the space fit for the stowage of general cargo, is the upper deck to the hull.

Enumerating the Decks:

In enumerating the decks, only those which are without such openings as exempt the spaces beneath from being included in the tonnage under the upper deck are considered. Other decks, if any, containing openings which would exempt the spaces beneath from inclusion in tonnage are separately described after the number of decks proper, e.g., "Two decks and shelter deck" or as the case may be. Partial decks, forward or aft, such as Orlop decks, are not considered as decks.

Register Heights: *See* Fig. 3

If the vessel has three or more decks to the hull, then the height from the top of the tonnage deck planking and/or plating to the under side of the planking and/or plating of the uppermost deck is the register height of the uppermost deck above the tonnage deck.

METHOD OF CARRYING OUT U.S. TONNAGE MEASUREMENT

1. The Tonnage Deck (*See* Fig. 3, App. I)

(*a*) The tonnage deck is the upper deck to the hull in vessels having not more than two decks and the second deck from the keel in vessels having more than two decks.

(*b*) If the tonnage deck consists of several partial decks extending with breaks from stem to stern, and if the partial decks are at different heights, the line of the lowest deck is taken as the tonnage deck and the headroom above such a line under the higher deck or decks is measured as a break.

(*c*) Engine and boiler casings, peak tanks and cofferdams are not considered as breaking the continuity of a deck.

In the majority of cases the tonnage deck can be determined from paragraphs (*a*), (*b*) and (*c*) but in the case of any unusual construction or doubt, guidance is usually sought from London office before measurement is commenced.

2. Tonnage Length

(*d*) The tonnage length is the longitudinal distance on the underside of the tonnage deck or line of same, from a point where the line of the inboard faces of the side frames or ceiling thereon, if any, intersects the side of the stem, to a point aft on the inboard face of the stern timber or cant frame, or ceiling, if fitted, thereon. (*See* Fig. 1.)

First consider a wood, iron or steel ship which has no double bottom but has floors of uniform or varying height. The underdeck tonnage is measured in one part and hence the above paragraph (d) is directly applicable. Having ascertained the measurement of the tonnage length, it is then to be divided into an even number of equal parts as required by the following table:—

Table I

Tonnage Length	Divisions	Sections
20′ 0″ or less	2	3
Above 20′ 0″ not exceeding 40′ 0″	4	5
,, 40′ 0″ ,, ,, 50′ 0″	6	7
,, 50′ 0″ ,, ,, 100′ 0″	8	9
,, 100′ 0″ ,, ,, 150′ 0″	10	11
,, 150′ 0″ ,, ,, 200′ 0″	12	13
,, 200′ 0″ ,, ,, 250′ 0″	14	15
Above 250′ 0″	16	17

British Rules

Table Ia

Tonnage Length	*Divisions*	*Sections*
30′ 0″ or less	*2*	*3*
Above 30′ 0″ not exceeding 50′ 0″	*4*	*5*
,, 50′ 0″ ,, ,, 120′ 0″	*6*	*7*
,, 120′ 0″ ,, ,, 180′ 0″	*8*	*9*
,, 180′ 0″ ,, ,, 225′ 0″	*10*	*11*
Above 225′ 0″	*12*	*13*

Assuming that the ship in question has a double bottom which is not uniform, then each point of discontinuity constitutes a break in the double bottom and the following procedure is then adopted:—

Breaks in Double Bottom

The tonnage length of a vessel having a break or a number of breaks in her double bottom exceeding 6 in. in height is divided into longitudinal parts establishing transverse vertical planes at the breaks. The length of each part is then divided into a number of equal parts according to the class in the foregoing Table I to which it belongs, just as if it were the length of a separate vessel. (*See* Fig. 4.)

British Rules

British Regulations establish a vertical plane at a break of any height, the length of each part then being divided into a number of equal parts according to the class in the foregoing Table Ia.

Having determined the number of parts into which the vessel should be divided, attention is now focused on the Transverse Sections.

3. Tonnage Depth

The depth, at the middle point of division of the tonnage length and measured from a point at a distance below the tonnage deck, equal to one-third of the round or one-half of the pitch of beam, down to the upper side of the floor timbers, floor plates, bottom floors alongside the keelson, longitudinals or tank top of a cellular double bottom as the case may be, is usually referred to as the "Tonnage Depth". (*See* Fig. 2.)

If ceiling is fitted on the bottom floor members, tonnage depths terminate on the upper face of the ceiling of average thickness, subject to a maximum permissible thickness of 3 in.

Should the vessel be required to be measured in parts and each part measured as a separate unit, then a tonnage depth is found for each part or unit at one-half its tonnage length. (*See* Fig. 4.)

The tonnage depth is important because it governs the number of parts into which it and all the remaining depths of the part in which it is located, are to be divided.

If the tonnage depth at the middle of the tonnage length of the vessel or part of same does not exceed 16 ft., then each depth is divided into four equal parts; but if the tonnage depth exceeds 16 ft., then each depth is divided into six equal parts. These are the points at which the tonnage breadths are measured.

Note.—The depth of each transverse section taken at its proper point of division of the tonnage length (as derived from Table I) is found in a manner similar to the measurement of the tonnage depth.

4. Tonnage Breadth

At each transverse section the depth for tonnage measurement is divided into the appropriate number of parts, as derived in 3, and at each point of division of the depth, a tonnage breadth measurement is taken.

Each breadth is measured to the inboard face of the ordinary frames or line of same, or inboard face of ceiling, battens or insulation of average thickness, if fitted, subject to a maximum permissible thickness of 3 in.

5. Areas of Transverse Sections

The areas of the transverse sections are obtained by utilising Simpson's first Rule, e.g.,

Breadth Number	Measured Breadth	Simpson's Multiplier	Function of Area
1	b_1	1	b_1
2	b_2	4	$4b_2$
3	b_3	2	$2b_3$
4	b_4	4	$4b_4$
5	b_5	2	$2b_5$
6	b_6	4	$4b_6$
7	b_7	1	b_7
			breadths $\times$ multipliers

Common Interval between breadths $=$ h

$\therefore$ Area Transverse Section $= \frac{1}{3} \times h \times$ breadths $\times$ multipliers.

6. Cubic Capacity of Space below the Tonnage Deck

By 5 above, the transverse area at each point of division of the tonnage length of the vessel is ascertained. The areas are then numbered successively 1, 2, 3, etc., for the vessel or each part of the vessel numbering from forward (the extreme limit of the length at the bow) to aft (the extreme limit of the length at the stern).

The cubic capacity of the space below the tonnage deck is then determined by use of the tonnage length or lengths, together with the calculated areas of transverse sections. Again utilising Simpson's first Rule, e.g.,

Transverse Area Number	Calculated Area	Simpson's Multiplier	Function for Volume
1	a_1	1	a_1
2	a_2	4	$4a_2$
3	a_3	2	$2a_3$
4	a_4	4	$4a_4$
5	a_5	2	$2a_5$
6	a_6	4	$4a_6$
7	a_7	1	a_7
			areas $\times$ multipliers

Common Interval between areas $=$ s

$\therefore$ Cubic Volume part $= \frac{1}{3} \times s \times$ areas $\times$ multipliers.

If the vessel is measured in one part, then the above formula gives the cubic capacity of space below the tonnage deck directly.

If the vessel is measured in more than one part then the addition of the capacities of each part given by the above formula results in the final cubic capacity of space below the tonnage deck.

7. Underdeck Tonnage

The cubic capacity of spaces below the tonnage deck divided by 100 gives the underdeck tonnage in tonnage tons.

8. Special Exempted Water Ballast Spaces

Of the total cubic capacity of spaces below the tonnage deck, spaces other than the double-bottom space, adapted only for water ballast and certified as being not available for the carriage of cargo, stores, supplies or fuel can be exempted from the underdeck tonnage measurement.

Adaptation for water ballast consists of having the space or spaces properly constructed and tested as ballast tanks ; the pumps, pipes, etc., for filling and emptying the tanks being of suitable dimensions, connected to the ballast system and completely independent of the cargo, fuel oil, feed or domestic water pumping apparatus.

Access is only allowed through oval or circular manholes, whose greatest diameter does not exceed 2 ft. in the watertight deck.

The manhole access must be fitted in the crown of a water ballast space to warrant its exemption from the gross tonnage. The fitting of a manhole access in the side plating invalidates it from exemption.

Where a hatch exists over a space which is going to be converted for the carriage of water ballast a welded or riveted watertight cover plate has to be fitted. A manhole as described above may be fitted in this cover plate and such manholes, except when fitted in the weather deck, may be provided with a coaming not exceeding 6 in. in height.

If these spaces are found being used for purposes other than water ballast, they cannot be exempted but are included in the gross tonnage of the vessel until such changes have been made as will definitely preclude their use for purposes other than water ballast.

The measurement of water ballast spaces is carried out in a similar manner to that for the underdeck. Their tonnage is then deducted from the gross underdeck tonnage resulting in the net underdeck tonnage which is used in assessing the gross tonnage of the vessel.

British Rules

All water ballast spaces (other than double-bottoms which are exempt) situated below the upper deck can be claimed as deductions *from the Gross Tonnage measurement.*

Application for the deduction of the water ballast spaces named is required in writing from the Builders or Owners, and the spaces are to comply with the following conditions:—

(1) *They are adapted only for water ballast.*

(2) *They are entered by an ordinary-sized manhole only, the dimensions of which must not exceed 24 in. $\times$ 18 in. if oval, or 22 in. in diameter if circular.*

(3) *That they are marked "Certified . . . . tons", inserting the name of the appropriate tank as the case may be, e.g., "Fore Peak", etc.*

(4) *The space deducted must be reasonable in extent.*

NOTE.—*Under British Rules a limit is imposed on the amount of water ballast which can be allowed as a deduction, based on the vessel's gross tonnage. In such cases a copy of the vessel's capacity plan is usually forwarded with the measurement to assist in assessing the amount of water ballast which can be allowed if the limit has to be imposed.*

Where deductions for water ballast spaces are claimed, it would, in many cases, save time and trouble if it was stated, when the measurements are submitted, that the conditions for exemption or deduction are fulfilled. Drawings and any other details of such spaces would also help.

9. VOID SPACES

Void spaces are *included* in the gross tonnage measurement.

They are only exempted or deducted if they have been fitted out as *bona fide* water ballast tanks in accordance with the requirements of paragraph 8.

NOTE.—An example of such void spaces may occur in modern large tankers where, due to structural requirements and loading conditions, special pre-selected tanks are permanently empty and are entered only by ordinary manholes.

Unless such tanks are fitted out as *bona fide* water ballast tanks, they are included in the gross tonnage measurement of the vessel.

10. BETWEEN DECKS

If a vessel has a third deck, the tonnage of the space between it and the tonnage deck is ascertained as follows:—

The length of the space is measured on the inside at the middle of its height, from a point forward where a continuation of the lines of inboard faces of the side frames intersect to the inside face of the stern or cant frames; battens, ceiling or insulation are taken into account subject to a maximum thickness of 3 in.

This length is divided into the same number of equal parts as the tonnage length is divided.

(If the vessel has been measured in parts due to breaks in her double bottom, then the between decks length is divided into an even number of equal parts as required by Table I, paragraph 2).

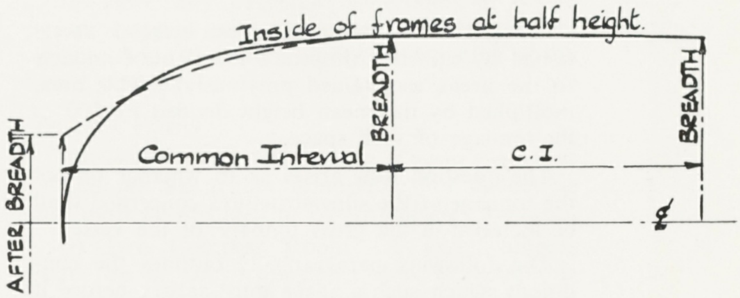
Breadths are taken at half height at each of the points of division of the length and also at the stem and stern.

NOTE.—If the stern is in the form of a continuous arc or curve, this breadth is taken as *one-half the preceding breadth*.

If the stern is in the form of an arc of a curve which is broken at its extreme after end by a decided flat, this breadth is taken as *two-thirds of the preceding breadth*.

BRITISH RULES

When computing the tonnage of a break, poop or space in an upper 'tween deck of similar form, the after and forward breadths used should be such that the true mean, horizontal area of the space will be determined. See following diagram.



The horizontal area at the mean height is obtained (as for the transverse section areas) by utilising Simpson's first Rule. This area, multiplied by the average height between the two decks and divided by 100, gives the tonnage of the between deck space and is included in the gross tonnage of the vessel.

If the vessel has more than three decks, the tonnage of each of the between decks above the tonnage deck is ascertained in the same manner and added to the gross tonnage.

11. SUPERSTRUCTURE

Permanent erections, i.e., forecastle, bridge, poop, break, etc., on or above the upper deck, are measured tier by tier, and, exclusive of closed-in exemptible spaces and open spaces, are included in the gross tonnage.

Length: The mean length is measured at half-height along the centre line, from and to the line of the inboard faces of frames, stiffeners, or ceiling if fitted.

The length is divided into an even number of equal parts, the common intervals of which are most nearly equal to that of the common intervals of the division of the tonnage length.

Breadth: The inside breadths are measured at half-height, one at each end and one at each point of division of the length.

NOTE.—ROUND END ERECTIONS

After end: If the after end of an ordinary poop or house is in the form of a continuous arc of a curve, its breadth at the extreme after end of its length is taken as *one-half of the preceding breadth*, and if it is in the form of an arc of a curve which is broken at its extreme after end by a decided flat, its breadth at the extreme after end of its length is taken as *two-thirds of the preceding breadth*.

Forward end: If the forward end of a house is in the form of a continuous arc of a curve, its breadth at the extreme forward end of its length is taken as *one-half of the succeeding breadth*,

and if it is in the form of an arc of a curve which is broken at its extreme forward end by a decided flat, its breadth at the extreme forward end of its length is taken as *two-thirds of the succeeding breadth*.

British Rules

See paragraph 10.

The horizontal area at the mean height is ascertained by utilising Simpson's first Rule (similarly to the areas ascertained previously). This area, multiplied by the mean height divided by 100, is the tonnage of such space.

The question now arises as to whether or not the tonnage of the superstructures concerned shall be included in the gross tonnage of the vessel.

The following paragraph 12 outlines the conditions which such a space must satisfy before it can be considered as being exempt from inclusion in the gross tonnage measurement.

12. Open Superstructure on or above the Upper Deck

(*a*) Nothing is to be added to the gross tonnage for any sheltered space on or above the upper deck which is under cover and open to the weather.

(*b*) In deciding whether or not superstructures are permanent closed-in spaces and should be included in the gross tonnage, the character and structural condition of such erections has to be considered.

(*c*) A forecastle, bridge, poop, or any other permanent superstructure on or above the upper deck to the hull, with one or more openings in its sides or ends not fitted with doors or other permanently attached means (except as provided for below) of closing them, is exempted from inclusion in the gross tonnage if the opening or openings are in conformity with the following provisions:—

(i) Tonnage openings in the end bulkhead of a poop, bridge or forecastle should have one tonnage opening at least 4 ft. wide by 5 ft. high in the clear *or its equivalent* situated as near as is practicable to the centre line of the space,

or

Two tonnage openings, each 3 ft. wide by 4 ft. high, in the clear, one on each side of the centre line of the end bulkhead.

An equivalent opening is considered to be one of at least 20 sq. ft. in the clear, resulting from a breadth in excess of 4 ft. and a height of not less than 3 ft.

(ii) Tonnage openings in intermediate bulkheads:—

If the space in question is sub-divided by intermediate bulkheads, these are to have openings or opening in them of the same dimensions as in (i).

(iii) Coamings:—

If coamings are fitted to tonnage openings, their height is not to exceed 2 ft. at any part.

(iv) Permissible temporary closures for exterior bulkhead tonnage openings:—

Tonnage openings prescribed for the abovementioned superstructure may be temporarily closed by shifting boards dropped into channel sections at the sides of the openings, or by plates or boards held in place by hook bolts, spaced not less than 1 ft. apart, fitting over the stiffener bar at the sides, top and bottoms of the openings, or by a plate or board held in place by bolts and crosspieces so arranged as not to be held in place by cleats or other attachments to, or bolts through, the bulkhead.

Cover plates, etc., must fay against the bulkhead.

(v) Battening, gaskets, etc.:—

The use of battening, caulking or gaskets of any material is not allowed.

(vi) Permanent fixtures:—

Cleats, stud bolts, hinges attached to, or bolts in bulkheads at the edges of tonnage openings are prohibited as they are considered to be part of the means, in conjunction with the plate or boards, of closing the tonnage opening.

(vii) Closures for interior bulkhead tonnage openings:—

The same temporary means of closing (*except by plates*), the tonnage opening in interior bulkheads are permitted.

British Rules

Interior tonnage openings may be closed by portable hook bolted plates.

(viii) An enclosure within an open space:—

An enclosure within an exempted space must be treated according to its use.

As stated in paragraph 11, certain spaces are exempted from inclusion in the gross tonnage.

These spaces, being closed-in spaces situated on or above the upper deck, are not included in the gross tonnage, provided they are reasonable in extent, and adapted and used exclusively for the purposes outlined. The following paragraph gives a brief summary of the spaces concerned.

13. Enclosed Spaces Exempted from Inclusion in Gross Tonnage

(*a*) Companions: Companions or booby-hatches serving as a protection for companionways (stairways or ladderways) leading to spaces below, whether such spaces are exempted or not.

(*b*) Galleys: Spaces fitted with ranges or ovens (bakeries) without regard to the category of persons they serve.

(*c*) Light and Air: Spaces forming part of the propelling machinery space, or serving for the admission of light and air to such machinery are exempt under the heading of light and air.

When no part of the propelling machinery extends below the upper deck, the space occupied by same is exemptible, in its entirety, together with such fuel bunkers as are located on or above the upper deck.

Where fuel bunkers or tanks are located wholly or in part below the upper deck, the space occupied below the upper deck is not deductible.

(*d*) Machinery spaces: Spaces occupied by machinery other than propelling machinery.

(*e*) Skylights: Skylights and domes providing ventilation and light to the erection underneath, except skylights over propelling machinery (included in light and air, see para. (c)).

(*f*) Water closets: Any public room or compartment if of reasonable size, fitted with hopper or hoppers is, for admeasurement purposes, a water closet.

This definition includes a room or a compartment designated as a toilet, fitted with urinal or urinals, shower bath or shower baths, in addition to the hopper or hoppers. A crew water closet is considered public if it serves more than one member of the crew.

British Rules

All water closets or privies (private or public) *for the officers and crew, and for passengers, except those which serve private suites or for which a charge is made, are exempt from inclusion in the gross tonnage measurement.*

(*g*) Wheelhouse: The space for sheltering the man or men at the wheel.

If the space is a combined wheelhouse and chartroom, only such space as is necessary for the proper steering of the vessel is exempted.

Should the space be partly above and partly below the upper deck, such part above the line of continuation of the deck is exemptible.

(*h*) Passenger cabins: Passenger cabins and staterooms immediately on the upper deck to the hull, permanently closed-in and fitted for permanent use of passengers, are included in the gross tonnage.

They are exempted only when they have no berthing accommodation and have only temporary arrangements to protect passengers on short voyages from rain and the shipment of seas, constituting sheltered spaces under cover and open to the weather; that is, not enclosed.

Cabins and staterooms, constructed entirely above the first deck which is not a complete deck to the hull, and for the use of passengers only, are exempted from inclusion in the tonnage.

For admeasurement purposes, a cabin is defined as an apartment of a vessel or the portion of the apartment that is assigned for the exclusive use of passengers.

A cabin may consist of staterooms, lounges, dining rooms, saloons, smoking rooms, play rooms, etc., individually or collectively.

The following spaces—smoking rooms, lounge, foyer, library and similar public spaces, with or without a stateroom would, for instance, be considered cabins.

In short, any passenger staterooms or public spaces reserved entirely for the use of passengers is considered as coming under the meaning of the word "cabin".

British Rules

Passenger cabins (including Owner's accommodation) are neither exemptible nor deductible *but must be included in Gross and Net tonnages.*

(*i*) Gyro Compass Room: A gyro compass space on or above the upper deck is exemptible as machinery other than propelling machinery.

Note.—*Paragraph (i) does not apply to British Rules.*

14. Open Shelter Deck Space

One other important superstructure above the upper deck which has to be considered is the open shelter deck 'tween decks and, for exemption of this space, the following conditions are to be satisfied:—

(*a*) Requirements for exemption: The space between the upper and shelter decks of a vessel is exempted from inclusion in the gross tonnage when there is a permanent middle-line tonnage opening in the shelter deck which is at least 4 ft. long in the clear and at least as wide in the clear as the after cargo hatch on that deck.

If any such opening is less than the minimum size as specified above solely because one or more corners of the opening are rounded, that space is exempted: (i) in any case in which the radius of curvature of each such corner is not greater than 5 in., or (ii) in any case in which a greater radius of curvature is required by the United States Coast Guard or by a recognised classification society.

(*b*) Position of the middle-line tonnage opening: The opening should be positioned so that the distance between the after edge of the opening and the aft side of the sternpost is not less than one-twentieth the register length of the vessel, or if the tonnage opening is forward, its fore side is not less than one-fifth the register length of the vessel from the stem.

British Rules

The ratio of the register length as given above is the same for compliance with the British Rules, but it should be remembered that the register length in each case is different.

(*c*) Coaming to middle-line tonnage opening: The coamings of the middle-line tonnage opening are not to exceed 12 in. extreme mean height above the deck, including the beading, etc., at the top for confining the hatch covers.

If any such opening is guarded by rails or stanchions then they are to be arranged so that they cannot be used to secure or assist in securing a cover over that opening.

British Rules

To comply with the British Rules, the opening should be fenced with guard rails and stanchions arranged as indicated above.

(*d*) Cover: If portable wood covers are fitted, then they may be held in place by lashings made of hemp, manila or other suitable material, fitted to the underside of the covers.

If, however, a metal cover is used, it may be held in place by hook bolts spaced not less than 18 in. apart, passing through the cover plate and hooked over angle stiffeners or flanges fitted on the outside of the coamings.

Note.—The bolts as a rule should not pass through the stiffeners or flanges on the coaming, nor should there be any other attachments on the coaming for fastening the cover.

British Rules

If portable wood covers are fitted, then they are to be held in place by hemp lashings fitted to the underside of the covers.

(*e*) Opening not to be enclosed: The middle-line tonnage opening in a shelter deck is not to be situated within a superstructure of any type.

(*f*) Tonnage openings in shelter deck space: When the permanent deck opening is situated aft, there is to be at least two openings, each 3 ft. wide by 4 ft. high in the clear, in each of the transverse bulkheads within the shelter deck space forward of the opening; or should the deck opening be forward, the same requirements apply to transverse bulkheads abaft such forward opening.

(*g*) Coamings: If coamings are fitted to tonnage openings in a shelter deck space, their height is not to exceed 2 ft. at any part.

(*h*) Temporary closures: *Excluding plates,* the same temporary means of closing tonnage openings in the tonnage bulkheads and in the intermediate shelter deck space bulkheads, if any, are permitted as described in paragraph 11 (iv), (v) and (vi).

British Rules

Interior shelter 'tween deck bulkhead tonnage openings may be closed by portable hook bolted plates.

(*i*) Well under middle-line tonnage opening: The well under the middle-line tonnage opening is to have a minimum length of 4 ft. throughout its entire breadth and height kept clear at all times.

(*j*) Scuppers: A scupper, having a 5 in. minimum inside diameter, fitted with a screw down non-return valve geared to and operated from the shelter deck, is to be fitted on each side of the upper deck in way of the permanent middle-line tonnage opening in the shelter deck.

(*k*) Means of closing: All openings in the upper deck to the hull are to be provided with proper means for closing and battening down.

(*l*) Closed-in spaces: Any closed-in space within an open shelter deck space is to be treated according to its use.

15. Hatchways

The tonnage of the hatchways is obtained by multiplying together the length, breadth and the mean depth (taken from the top of the beam to the underside of the hatch cover), and dividing the resulting product by 100.

From the aggregate tonnage of the hatchways is deducted one-half of 1 per cent of the gross tonnage of the vessel exclusive of the tonnage of the hatchways, and the remainder only is added to the gross tonnage as *excess* hatchways.

The hatchways referred to are the ones out in the open or in open spaces on the upper deck to the hull and on closed-in deck erections.

Hatchways in between decks and on the portion of the decks within closed-in erections on the upper deck to the hull are automatically included in the between-deck spaces and in the erections by the process of measurement, also the hatchways on decks of open erections are not considered as they serve spaces not included in the tonnage of the vessel.

16. Gross Register Tonnage

The gross tonnage referred to in the foregoing and following paragraphs is the gross register tonnage, i.e., the gross tonnage exclusive of all permissible exempted spaces and consists of the following items:—

(i) The underdeck tonnage excluding exemptible water ballast spaces within the measurable portion of the vessel.

British Rules

Water ballast spaces within the measurable portion of the vessel are included.

(ii) The tonnage of each between deck space above the tonnage deck.

(iii) The tonnage of the permanent closed-in spaces on the upper deck available for cargo or stores, or for the accommodation of passengers and/or crew.

(iv) The tonnage of all permanent closed-in spaces situated elsewhere available for cargo or stores, or for the accommodation of the crew or for the charts, except cabins or staterooms for passengers constructed entirely above the first deck which is not a deck to the hull.

British Rules

Cabins or staterooms for passengers or owners constructed entirely above the first deck which is not a deck to the hull are included in the gross tonnage.

(v) The excess of hatchways.

Having ascertained the gross tonnage, attention is now focused on the net or net register tonnage.

17. Net Register Tonnage

The net register tonnage is the tonnage of a vessel remaining after the authorised deductions have been made from the gross register tonnage.

Requirements: No space is deducted unless it has been included previously in the vessel's gross tonnage, is reasonable in extent for the purpose to which it is appropriated, and is certified by marking as prescribed later, showing that it is used exclusively for such purpose.

18. Authorised Crew Space Deductions

(*a*) Crew spaces: The tonnages of the spaces or compartments, exclusively occupied and appropriated to the use of the officers and crew of the vessel. This definition includes the following spaces:—

(i) Bathrooms: A bathroom is considered as being a compartment or room containing a bath tub, or a bath tub and a water closet, or a shower bath or showers without a water closet, regardless of its location.

British Rules

A compartment or room containing a bath tub and a water closet is exempt from the gross tonnage if situated above the upper deck.

If situated below the upper deck, it is allowed as a deduction.

(ii) Clothes drying room.

(iii) Drinking water filtration or distilling plant below deck.

(iv) Hospital.

(v) Crew mess rooms.

(vi) Officers' mess rooms.

(vii) Office of Chief Engineer.

British Rules

Offices of Chief Officer and Chief Engineer. Ships' offices also if used by officers of either department, but not if there are separate offices for the Chief Officer and Chief Engineer.

Note.—*Where offices are continuous to and extend from the cabin of Chief Officer or Chief Engineer and are fitted out as living spaces, i.e., with sofa, etc., they are treated as day rooms and deducted.*

(viii) Oilskin locker.

(ix) Pantry.

(x) Recreation room.

(xi) Shower bath.

(xii) Sleeping rooms.

(xiii) Smoking room.

(xiv) Private water closets: A private water closet is one intended to serve not more than one member of the crew, whose stateroom or bedroom affords the only means of entrance thereto and is treated as part of the room served by it. Other water closets are considered to be public water closets for admeasurement purposes.

British Rules

Water closets intended to serve not more than one member of the crew, if situated above the upper deck are exempted.

If situated below the upper deck they are deductible.

(xv) Public water closets: Below the upper deck.

(xvi) Passageways and companionways serving the above spaces.

Note.—(*a*) None of the above spaces is deducted when used by passengers nor are the clerk's, Purser's or Paymaster's offices.

(*b*) Non-deductible spaces on a deductible passageway: Lockers of less than two tons, containing medicine, linen, mops, etc., for the free use of the crew, the ship's office, and spare rooms not exceeding two in number and used as required by a pilot, customs officers, reserve engineer, or company official or employee, do not invalidate the deduction of a passageway serving as sole access to their location.

British Rules

Note.—*Lockers containing medicine for the sole use of the crew are deductible.*

(*c*) Master's cabin: Spaces exclusively for the use of the Master, e.g., sleeping room, dressing room, bathroom, office, and passageways serving his accommodation.

British Rules

If the bathroom of the Master contains a w.c. then it is exempted from the gross tonnage.

If the bathroom and w.c. are in separate rooms, then the w.c. may be exempted and the bathroom deducted from the gross tonnage.

19. Authorised Navigation Space Deductions

Spaces used exclusively for manœuvring or navigating the ship are deducted from the gross tonnage to the extent of what is considered reasonable.

When the steering gear, anchor gear, helm, etc., are situated within a room unnecessarily large for the purpose, or are not partitioned off at all, a 2 ft. allowance on every side of the apparatus is made for working space.

The following spaces, except as otherwise stated, are allowed as deductions under paragraph 19:—

(*a*) Anchor gear: The spaces below occupied by anchor gear (i.e., chains or cables, machinery, etc., for handling the anchor) including the capstan, windlass and chain locker.

(*b*) Boatswain's stores: Any space exclusively appropriated to and used for keeping the boatswain's stores may be deducted, subject to the restriction stated below.

These spaces include the spaces for storing paints, oils, blocks, hawsers, rigging, deck gear, etc., in charge of the boatswain and for daily use on the vessel.

NOTE.—The allowance for boatswain's stores is 1 per cent of the gross tonnage in vessels of 100 tons gross and over, but this allowance is not to exceed 100 tons.

In the case of vessels of less than 100 gross tons, this deduction is not to exceed 1 ton.

BRITISH RULES

Lamp and paint rooms are not considered as being boatswain's stores under British Rules.

Lamp rooms are deducted as a separate item and paint rooms are neither exempted nor deducted.

NOTE.—*The allowance for boatswain's stores is 1 per cent of the gross tonnage in vessels of 1,000 tons and over, but this allowance in no case is to exceed 75 tons.*

In vessels from 500 – 1,000 tons gross, the limit is 10 tons.

In vessels from 150 – 500 tons gross, the allowance is 2 per cent of the gross tonnage.

In small vessels under the 150 tons, the allowance is not to exceed 3 tons.

(*c*) Chart room: The space for keeping the charts, nautical instruments and for plotting the course. When the space is a combined wheel and chart room, such part as is not exempted as wheelhouse is deducted.

In small vessels requiring the use of navigation charts, and where the cabin or saloon is the only place available for filing or use of such charts one-half of the cabin or saloon is allowed for this purpose, provided the allowance does not exceed $1\frac{1}{2}$ tons.

BRITISH RULES

In small vessels the requirements as outlined for U.S. Rules apply to British Rules except that the allowance is limited to 3 tons.

(*d*) Donkey engine and boiler: If the space occupied by a donkey engine and boiler is situated within the boundary of the engine room or casing above it, and if the donkey engine is used as an auxiliary in connection with the main machinery for propelling the vessel, and this space forms part of the actual engine room, then it is not subject to a separate allowance.

When the donkey engine and/or boiler is in a house above the upper deck and not used in connection with the main propelling machinery as described above, the space thus occupied is an exemption and therefore is not included in the gross tonnage of the vessel.

In all other cases, the space occupied by the donkey engine and boiler, if the same are connected with the main pumps (except cargo pumps) of the vessel, is allowed as a deduction from the gross tonnage, if reasonable in extent, and is certified in the same manner as other deductible spaces.

(*e*) Dynamo spaces: The space or spaces when reasonable in extent, occupied by dynamos, switchboards and apparatus necessary for the operation of same, when located below the upper deck are deducted regardless of the service for which the dynamo or dynamos are used.

BRITISH RULES

Dynamo spaces situated below the upper deck get no allowance nor are they included in the engine room measurement.

(*f*) Pump room: A pump room or space below the upper deck containing the pumps of the vessel which are used solely for handling ballast, feed water, water for cleaning purposes and for freeing the ship of water entering her hold, etc., is deducted as a pump room.

A pump room or space below the upper deck containing pumps primarily used for handling cargo, as in the case of bulk oil carriers, is not deducted.

NOTE.—If a pump room or space below the upper deck contains ballast pumps as well as oil fuel transfer pumps, then the proportion of the space occupied by the ballast pumps is allowed as a deduction.

The portion of any of the above pump spaces above the upper deck is exemptible as machinery space.

BRITISH RULES

In all cases, the amount deducted is limited to the actual space occupied by and necessary for working the pumps, together with that strictly necessary for access to them.

(*g*) Radio house: The space set apart for sending and receiving wireless messages.

(*h*) Gyro compass space: The space occupied by the gyro compass when situated *below* the upper deck.

See also para. 13(*i*).

BRITISH RULES

The space occupied by the gyro compass and situated either above or below *the upper deck to be allowed as a deduction from the gross tonnage.*

(*i*) Battery locker: The space set apart for housing batteries used in connection with the W/T apparatus.

BRITISH RULES

Storage spaces: Spaces such as cold stores, potato, stewards' and provision stores are allowed as a deduction, subject to the allowance not exceeding 15 per cent of the other deductions for master's and crew accommodation.

20. MEASURING DEDUCTIBLE SPACES

Deducted spaces, rectangular in shape, are measured by taking the product of the three dimensions, length, breadth and height.

When the space is bounded by curved surfaces conforming to the sides of the vessel below the tonnage deck but not exceeding 15 ft. in length, then the space may be measured by any practical method.

21. MARKING OF DEDUCTIBLE SPACES

Deductible spaces are to be marked as follows: —

(i) For each space appropriated exclusively for the use of the Master, including the Master's bathroom, bedroom, dressing room, observation room, office, reception room, sitting room and water closet: —

"CERTIFIED FOR THE ACCOMMODATION OF THE MASTER"

(ii) For each space appropriated exclusively for the use of crew members, including Officers other than the Master: —

"CERTIFIED TO ACCOMMODATE——SEAMEN"

(iii) For other deductible spaces: —
"CERTIFIED———" inserting the appropriate designation such as "BOATSWAIN'S STORES", "CHART HOUSE", "DYNAMOS", "GALLEY", "HOSPITAL", "MESS ROOM", "OFFICE OF CHIEF ENGINEER", "PUMP ROOM", "RADIO", "STEERING GEAR", "W.C.", ETC.

It should be noted that the following abbreviations may be used: —

"CERT. ACCOM. MASTER"
"CERT. ACCOM.———SEAMEN"
"CERT. BOATSWAIN'S STORES"
"CERT. W.C."
or
"CERT.———" inserting the space designation.

The marking is required to be in Roman letters and Arabic numerals at least half an inch in height, embossed, centre punched, or otherwise permanently cut in metal, and painted over with oil paint in a light colour on a dark background, or a dark colour on a light background, or carved or branded at least three-eighths of an inch in wood over the doorway, or the inside of the deductible space.

If desired, the marking may be made on a plate of metal (but not of other material), permanently fastened in place by means of welding, riveting or lock-type screws.

BRITISH RULES

Paragraph 21 also applies to the British Rules but with regard to the navigation space deductions, the actual tonnages of the spaces are also marked, e.g., a lamp room would be marked "CERTIFIED LAMP ROOM . . . . TONS.".

22. DEDUCTION FOR PROPELLING POWER

The remaining important deduction to be ascertained is the deduction for propelling power.

In the case of a vessel propelled by steam or other power, a deduction is made for the propelling machinery space according to the percentage ratio between the actual tonnage of such space and the vessel's gross tonnage, calculated as follows: —

For vessels propelled by screw in whole or in part: 13 per cent or less.

32/13 times the tonnage of the actual propelling machinery space is deducted; or, in the case of a vessel the construction of which was commenced on or before June 4th, 1956, if the owner so selects, one and three-quarter times the tonnage of the actual propelling machinery space is deducted.

Above 13 per cent but below 20 per cent: 32 per cent of the gross tonnage is deducted.

20 per cent or more: 32 per cent of the gross tonnage or one and three-quarter times the tonnage of the actual propelling machinery space is deducted, whichever the owner selects.

For vessels propelled by paddle-wheel in whole or in part: —

20 per cent or less: 37/20 times the tonnage of the actual propelling machinery space is deducted; or, in the case of a vessel the construction of which was commenced on or before June 4th, 1956, if the owner so selects, one and a half times the tonnage of the actual propelling machinery space is deducted.

Above 20 per cent but below 30 per cent: 37 per cent of the gross tonnage is deducted.

30 per cent or more: 37 per cent of the gross tonnage or one and a half times the tonnage of the actual propelling machinery space is deducted, whichever the owner selects.

BRITISH RULES

RESTRICTION ON ALLOWANCE FOR PROPELLING POWER

The Merchant Shipping Act, 1907, provides that in all steamships except tugs exclusively used in towing, the deduction for propelling power is not to exceed 55 per cent of that portion of the tonnage which remains after deducting from the gross tonnage any crew space and other deductions allowed under Sect. 79 (Navigation Spaces).

When tugs are used for purposes other than towing, the restriction as to propelling power is applied.

23. ENGINE ROOM

(*a*) The engine room is measured, regardless of size, in order to ascertain whether the allowance to be deducted for propelling power can be regulated by a percentage of the gross tonnage or by the actual tonnage of the engine room ascertained by measurement.

(*b*) No space is included in the tonnage of the engine room unless it has first been included in the vessel's gross tonnage.

(*c*) Conversely, the spaces occupied by cabins, storerooms, etc., and any space not used in connection with propelling the vessel but included in the tonnage of the engine room through process of measurement, must be subtracted therefrom.

24. Spaces to be included in Engine Room

The space occupied by the engine room is understood to include not only that occupied by the engine room itself but also the space occupied by the boiler room, together with the spaces strictly required for the working of the engines and boilers, and consisting of the following items:—

(i) Space below the crown: The crown or top of the main space of the actual engine room, from which the depths of the main space are taken, will either be at the underside of a deck or, if the side bulkheads are sloping, at the point or height at which the slope terminates.

(ii) Space between crown and upper deck: Space between the crown and the upper deck framed in for the machinery or for admission of light and air.

(iii) Space above upper deck: Space above upper deck framed in for machinery or for admission of light and air. (*See* paragraph 26(a).)

(iv) Shaft tunnels, etc.: The shaft tunnel or tunnels and the thrust block recess.

(v) Escape shaft: The trunked ladderway leading from the after end of the shaft tunnel to the deck, provided it is no larger than is necessary for the purpose of access to and escape from the shaft tunnel.

The part of an escape shaft above the upper deck line, also the companion sheltering the escape shaft, is treated as light and air space.

(vi) Fuel oil transfer pump: When the fuel oil transfer pump is located in a separate space, this space, if reasonable in size, is considered propelling machinery space, provided the pump is not used for bunkering the vessel.

Should such a pump perform the dual service of handling both ballast and transferring fuel oil to the settling tanks, one-half the space is credited to propelling machinery space.

(vii) Settling tanks: Fuel oil settling tanks used solely for rendering crude oil fit for consumption in the main boilers are considered as being part of the propelling machinery space. The permissible allowance for settling tanks is based on a four days' supply under full steam, which allowance is not to exceed 1 per cent of the vessel's gross tonnage.

(viii) Engineers' stores and workshops: The engineers' stores and/or workshops are regarded as part of the engine room, up to three-quarters of 1 per cent of the gross tonnage if in the engine room, open to same, or separated therefrom only by a screen bulkhead.

Note.—Electricians' stores are not considered as being engineers' stores and hence are deducted from the engine room measurement.

British Rules

Engineer's stores are not considered as forming part of the engine room and hence are deducted from the engine room measurement.

25. Measurement of Engine Room

(*a*) Engine room situated amidship: When the propelling machinery (boilers and engine) is situated amidship, and without a break in its bottom or side lines, its length is measured between the foremost and aftermost bulkheads, or limits of its length, excluding such parts, if any, not actually occupied by or required for the proper working of the machinery.

This length is divided into two, and three depths are taken, one at each end and one at the middle of the length, taking the depths from the crown, or line of same, to the ceiling on the bottom frames or floor timbers, or to the tank top in the case of a steel vessel.

At one-half their respective heights a breadth is measured and the product of the length, mean breadth and mean depth, divided by 100 gives the tonnage of the main space below the crown.

(*b*) Engine room situated at aft end: When the propelling machinery space is located in the after end of a vessel, extends from side to side and has a continuous bottom line, its length is divided into such an even number of parts as will give a common interval most nearly equal to that used when finding the tonnage of the hold in that part of the vessel. The tonnage of the engine room is found by use of transverse areas and Simpson's First Rule.

(*c*) Engine room measured in parts: If the boilers and engine are entirely in separate spaces, or if there is a break or breaks in the bottom or side lines of the propelling machinery space resulting from a break or breaks in the double bottom or varying height of floors thereunder, or from side bunkers or other spaces not considered propelling machinery spaces, each space is measured separately as a whole or in parts, according to the number of breaks in its bottom or side lines and the sum of the several results will give the tonnage of the spaces.

(*d*) Spaces between the crown and upper deck: The tonnage of the space or spaces, if any, between the crown and the upper deck, or line of same, which are framed in for the propelling

machinery or admission of light and air is estimated by multiplying together the length, breadth and depth thereof, and dividing the product by 100.

(*e*) Shaft tunnel and thrust recess: In the case of screw propelled vessels in which the top of the shaft tunnel is flat, the tonnage of the tunnel is ascertained by dividing the product of its length, breadth and depth by 100.

In a similar manner the tonnage of the thrust recess or entrance to the shaft tunnel can be found.

If the space abaft the shaft tunnel extends from side to side of the vessel, its tonnage is found by application of Simpson's First Rule.

(*f*) Round top shaft tunnel: When the top of the shaft tunnel is semi-circular in shape, the area of a transverse section is found by taking the lower part as a rectangle and the upper part as a semi-circle.

The sum of these two areas multiplied by the length of tunnel and divided by 100 gives the tonnage of this space.

By adding together the tonnages of the spaces as stated in paragraph 24, where applicable, the gross engine room tonnage can be ascertained.

To ascertain the net engine room tonnage, all spaces occupied by auxiliary machinery not used in connection with propelling the vessel are to be measured and the sum of their tonnages deducted from the gross engine room tonnage.

26. Light and Air Spaces

(*a*) On a request in writing by the owner of a vessel being measured for tonnage, the tonnage of the spaces above the crown of the engine room and above the line of the upper deck framed in for machinery, or for the admission of light and air, may, for the purpose of ascertaining the tonnage of the space occupied by the propelling machinery, be added to the main machinery space, but it should also be included in the gross tonnage.

(*b*) Extent of light and air spaces: When measuring light and air spaces, the admeasurer should ensure that the length of the space does not exceed the length of the main propelling machinery space, and also that the breadth of casing allowed does not exceed one-half the extreme inside midship breadth of the vessel.

(*c*) Purpose for including light and air spaces: The purpose of adding the tonnage of part of the framed-in light and air spaces of a vessel to her main machinery space tonnage is to entitle the vessel to a greater deduction for propelling power, and consequently obtain a smaller net tonnage than would otherwise result. The actual amount of light and air spaces which need to be added to the main machinery space tonnage to obtain this benefit can be ascertained as follows:—

(i) Ascertain 13·1 per cent of the gross tonnage inclusive of excess of hatchways.

(ii) Find the difference between this per cent and the tonnage of the main propelling machinery space below the upper deck to the hull.

(iii) Increase this difference by 15 per cent of itself, which gives approximately the amount of light and air space which needs to be added to the main propelling machinery space tonnage. This amount of light and air will also have to be added to the gross tonnage. Hence the gross register tonnage in such a case would be the gross tonnage plus light and air addition less one-half of 1 per cent of said light and air addition. The ½ per cent is additional allowance for excess hatchways due to addition of light and air to gross tonnage.

Example

		Tons
Gross tonnage, exclusive of light and air and hatchways		5,675·95
Excess of hatchways (based on the above gross)		67·37
Gross tonnage, inclusive of excess of hatchways and exclusive of light and air		5,743·32
13·1 per cent of 5,743·32 ...	752·37	
Machinery space below upper deck and hull	680·55	
Difference ...	71·82	
15 per cent of difference ...	10·77	
Sum ...	82·59	
∴ amount of light and air to be added to the gross tonnage and machinery space = 82·59		82·59
Gross tonnage, inclusive of light and air and excess of hatchways		5,825·91
Additional exemption for hatchways (equals half of 1 per cent of 82·59 = 82·59/200)		·41
∴ Gross Register tonnage		5,825·50

Check

13·1 per cent of 5,825·50 = 763·14
680·55 + 82·59 = 763·14

Hence the deduction for propelling power can be ascertained.

Note.—It is important to ascertain whether the owner requires the addition of the necessary light and air to obtain the maximum propelling power deduction. In certain cases, for his own reasons, the owner may require the smallest gross tonnage and in these instances he will not require the addition of light and air spaces which increase the gross tonnage measurement.

27. Net Register Tonnage

The Net Register Tonnage is the tonnage of a vessel remaining after the authorised deductions (as given in paragraphs 18–26) have been made from the Gross Register Tonnage.

The system of measurement outlined in the preceding paragraphs also applies to small craft but little reference to differences which may arise in the measurement of deckhouses and machinery spaces has been made. It is thought that omission of reference from these notes to such difference would be an injustice to Surveyors who may be called upon to do such a measurement and it is now proposed, therefore, to give some notes for guidance of these differences.

28. Superstructures on Small Craft

Superstructures on small craft are measured in a manner similar to the method outlined in paragraph 11.

When a superstructure is erected over a cut-away portion of the tonnage deck, its height is taken from the underside of its covering deck to a line of continuation of the tonnage deck.

After subtracting the tonnage of exemptible spaces in the superstructure, the remainder should be listed under a name describing the erection among the items comprising the gross tonnage.

29. An Open Structure on Small Craft

A house on a small craft is considered open to the weather and exempted from inclusion in tonnage provided its after end is entirely open, from the underside of its roof beams down to a coaming not exceeding 3 in. in height, if there is a coaming, otherwise to the deck or line of same, and open in an athwartship direction from and to the inboard face of the end side stiffeners. Such an opening may be guarded by wire mesh screens and/or temporarily closed by canvas secured at the top and lashed down or battened in place at the sides and bottom.

Closed-in spaces within an open erection are treated according to their use.

30. Open Vessels

(*a*) In ascertaining the tonnage of open vessels the upper edge of the upper strake forms the boundary line of measurement, and a tonnage depth is taken from a line athwart the upper edge of said strake, at each point of division and each end of the tonnage length.

(*b*) An open vessel is one of any length without a deck, or with only a partial deck or decks, the total length of which is less than one-half her tonnage length.

(*c*) A vessel having a tonnage length of less than 50 ft. and a partial deck of any length or a single full length deck which, in either case, lies more than one-sixth of the midship depth below the line of the upper edge of the upper strake to the usual point in the hold for taking the register depth, is for admeasurement purposes, an open vessel unless it has a mechanically refrigerated hold or holds.

31. Engine Room in Small Craft

(*a*) Not bulkheaded off: In the case of a motorboat not having an engine room bulkheaded off from the rest of the hold, the space occupied by the engine and sufficient space on each side and end of it—say, about 2 ft.—to permit the operator to handle it safely and efficiently, is allowed as engine space.

If space does not exist for such an allowance then whatever space there is can be allowed.

Fuel tanks are not included in the engine space.

(*b*) Bulkheaded off: If the engine is bulkheaded off from the rest of the hold and is larger than is strictly required for safe and efficient handling of the engine, the engine space is limited as indicated in paragraph (*a*) above.

(*c*) Engine on a bed: If the engine sits on a bed located on the vessel's bottom timbers, depths when measuring the propelling machinery space are taken from the underside of the deck or line of same, down to the top of the bottom frames or floor timbers as the case may be, or to the ceiling thereon when fitted.

(*d*) Boxed-in engine: When a portion of the engine extending above a cockpit platform is boxed-in, such boxed-in portion is considered as being all of the space available for the installation and operation of the engine above the line of said platform in that part of the vessel.

In the case of a wholly boxed-in engine in the hold of a motorboat, the tonnage of the boxed-in space, plus the shaft, engine auxiliaries, etc., that may be outside the boxing, are considered the propelling machinery space.

Note.—The above restrictions may invalidate light and air exemption when the boxing does not extend above the line of the upper deck. When such boxing does extend above said deck line, the height of light and air exemption is from the upper deck line to the underside of the top of the boxing.

The deduction from the gross tonnage measurement is made in compliance with paragraph 22 according to the percentage ratio between the actual tonnage of such space and the vessel's gross tonnage.

GENERAL REQUIREMENTS

On completion and recording of all measurements on the forms provided they are forwarded to London office for checking, together with the following if available:—

1. A general arrangement plan of scale not less than $\frac{1}{8}$ in. to the foot.
2. Cabin plan arrangements of scale $\frac{1}{4}$ in. to the foot.
3. Drawings to a suitable scale showing the arrangements of the machinery spaces.
4. A tonnage plan to a suitable scale showing the half breadths of sections at the point of division of the tonnage length of the vessel into

the number of equal parts in accordance with Table I, page 5, for the measurement of spaces under the tonnage deck.

5. Any other drawings or explanations which will be of assistance when checking the tonnage measurement.

6. Measurement and details of all exempt spaces are shown on the tonnage forms together with verification that any water ballast spaces for which exemption from the gross tonnage is being claimed conform generally with the requirements outlined in paragraph 8, page 6.

NOTE.—If a small craft were to be measured for which no drawings were available, a rough sketch of the general arrangement of the vessel would be made showing all the necessary dimensions.

In connection with the issue of a Tonnage Certificate to a vessel, certain requirements have to be complied with. These requirements are usually of the following nature:—

1. Vessel's name to be marked on each bow.
2. Vessel's name and port of registry to be marked on stern.

NOTE.—The smallest letters used in either case should not be less in size than 4 in.

3. Draught marks on each side of stem and stern post to be verified.
4. (*a*) The official number of the vessel, preceded by the abbreviation "NO." and the net tonnage (omitting fractions .... tons), preceded by the word "NET", to be marked in a conspicuous place on the face of the main beam.

NOTE.—

(i) The beam at the forward end of the largest hatch on the weather deck, which is generally located forward of amidships, to be considered the main beam.

(ii) In the case of a vessel which does not have a hatch on the weather deck, any structural member which is integral to the hull may be considered the main beam.

(*b*) The markings should be in plain Arabic numerals not less than 3 in. in height when the size of the main beam will permit and plainly cut out or centre punched. The markings should then be painted over with oil paint in a light colour on a dark background or a dark colour on a light background. If a main beam is of wood, the markings should be carved or branded in figures not less than $\frac{1}{8}$ of an inch in depth.

(*c*) Any previous markings to be completely expunged.

5. Deducted spaces to be marked in accordance with paragraph 21.

NOTE.—In the case of a vessel of Liberian registry, the vessel's name should be conspicuously placed in distinct plain letters, of not less than 6 in. in length, on each outer side of the pilot house.

When the above requirements have been dealt with, the tonnage certificate and copies should be signed by the owner or owner's representative in the appropriate space and then signed by the Surveyor and stamped.

The original and one copy should then be handed to the owners, the remaining copies being returned to London office.

EXISTING VESSELS

The foregoing system of admeasurement, on the whole, applies to new vessels. It is now proposed to consider the procedure to be adopted when a vessel is transferred to Liberian, Panamanian or Nicaraguan registry.

It is usual to inform London office immediately and forward, if available, the following documents:—

1. A copy of the existing tonnage certificate.
2. A general arrangement plan.

If the above documents are available or can be obtained, then the actual measurement to be taken on the vessel concerned should, as a rule, be limited to the following items:—

1. Details and measurement of all engineers' stores and/or workshops in machinery spaces, open to same or separated therefrom only by a screen bulkhead.
2. Details and measurements of the following non-propelling power auxiliaries if situated in the engine room:—
   (i) Cargo pumps and associated equipment.
   (ii) Storage tanks for oil or water.
   (iii) Auxiliary condensers and associated equipment unless used for essential propelling power items.
   (iv) Refrigeration equipment.
   (v) Compressors not required for the main propelling machinery.
   (vi) Electrical generators with their associated auxiliaries and switchboard except that portion of their tonnage based on wattage as may be required for the main machinery and its essential auxiliaries.
3. Details and measurements of any space occupied exclusively by passengers and/or owner.
4. Details of spaces, excluding double bottoms, used exclusively for the carriage of water ballast.
5. Details and measurements of fuel oil settling tanks but not lubricating oil settling tanks should be reported whether situated within or outside the machinery space.
6. Measurements of the forward auxiliary pump room and access trunk from this pump room to upper deck. Type and number of pumps fitted should be stated, e.g., 1 in No. ballast pump and 1 in No. oil fuel pump.

From this information as a rule, the new tonnages in accordance with the U.S. tonnage regulations can be computed.

If the above information is not available, however, then it may be that the vessel concerned would have to be completely re-measured. The necessary instructions and guidance will usually be sent to the Surveyors concerned from London office.

CONCLUSION

The Authors would like to refer to one aspect of the measurement which has not been mentioned in the foregoing paper. In the "Instructions to Surveyors" Part 4, 1956, it states that it is quite justifiable to use the working "lines" plan or scrieve board in measuring offsets for the calculation of the underdeck tonnage, provided the lines plan is itself verified by actual measurement on the vessel. The Authors would suggest, however, that, wherever possible, the tonnage measurements should be taken on the vessel itself. The Authors appreciate that in certain cases, due to circumstances outside the Surveyors' control, such a task as actually measuring a vessel within a given time or for other reasons, may be humanly impossible, and in such a case, the Authors consider that if a scrieve board is available then the procedure as outlined in the "Instructions to Surveyors" could be adopted.

It should also be borne in mind that, if the vessel is being measured by the National Authority of the country in which the vessel is being built, then it is advisable for the Surveyor concerned to consult with the National Authority's Surveyors to ensure that the measurements of each agree so that, when making allowances for the differences in the respective regulations, the final computed tonnages are comparable. Finally, the Authors would stress again that, if Surveyors are in doubt as to how to proceed with any measurement, then they should request London office for guidance.

The Authors would like to express their appreciation of the help given by members of the Staff towards the preparation of this paper.

REFERENCES

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APPENDIX I

DIAGRAMS

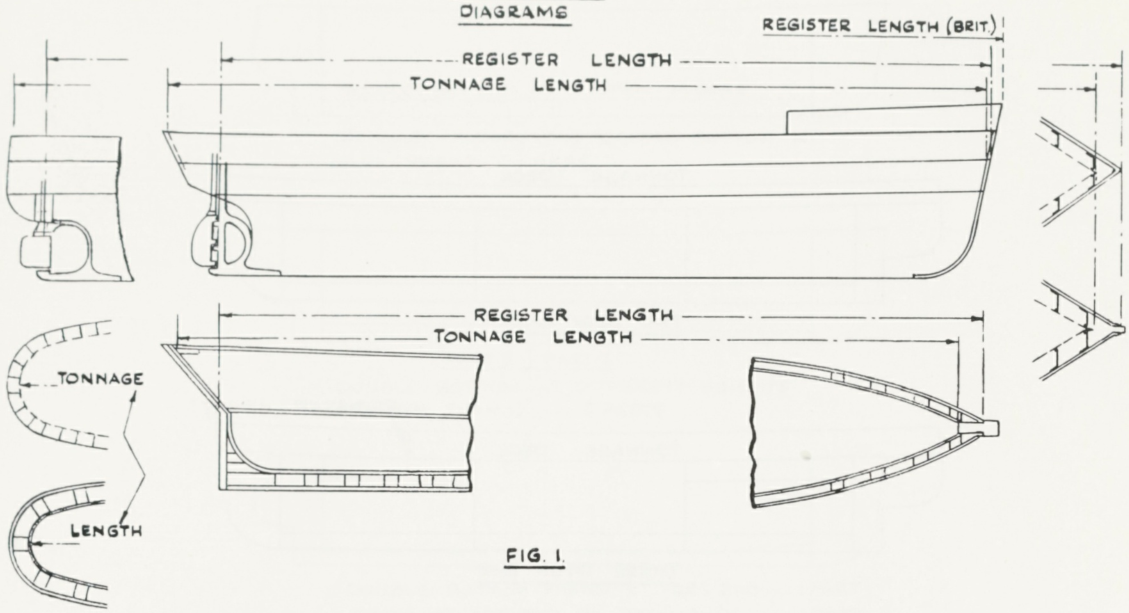


FIG. 1.

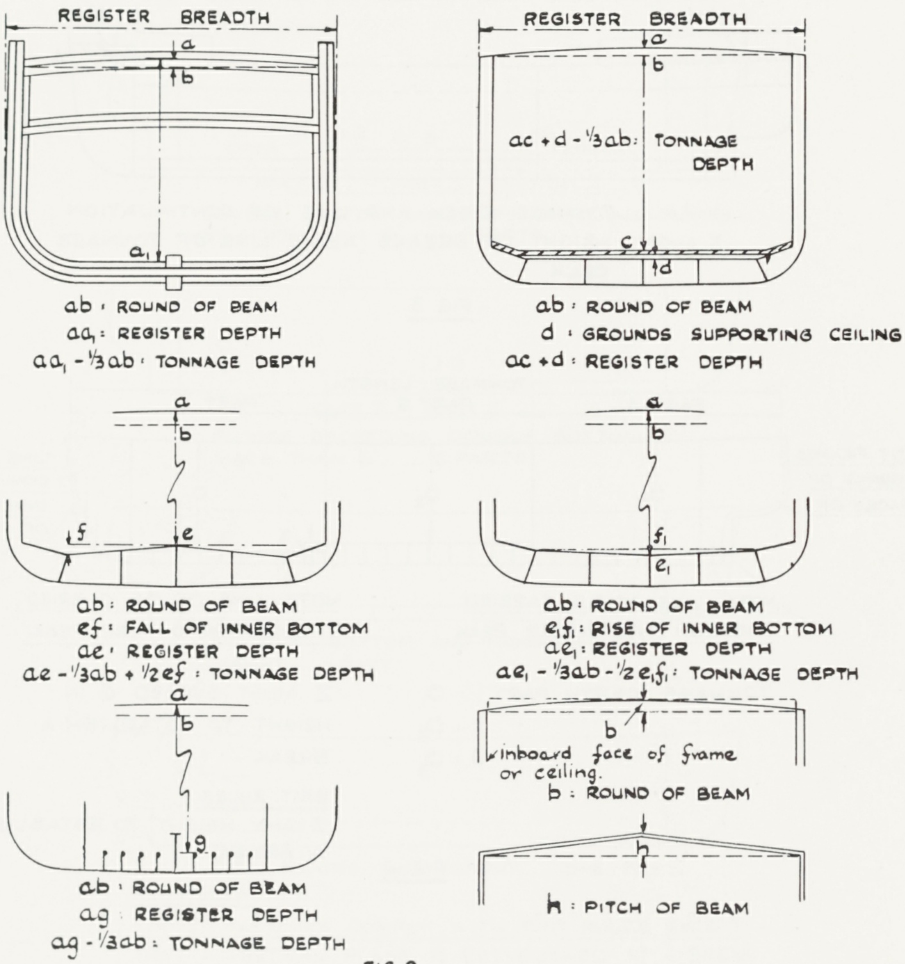


FIG. 2.

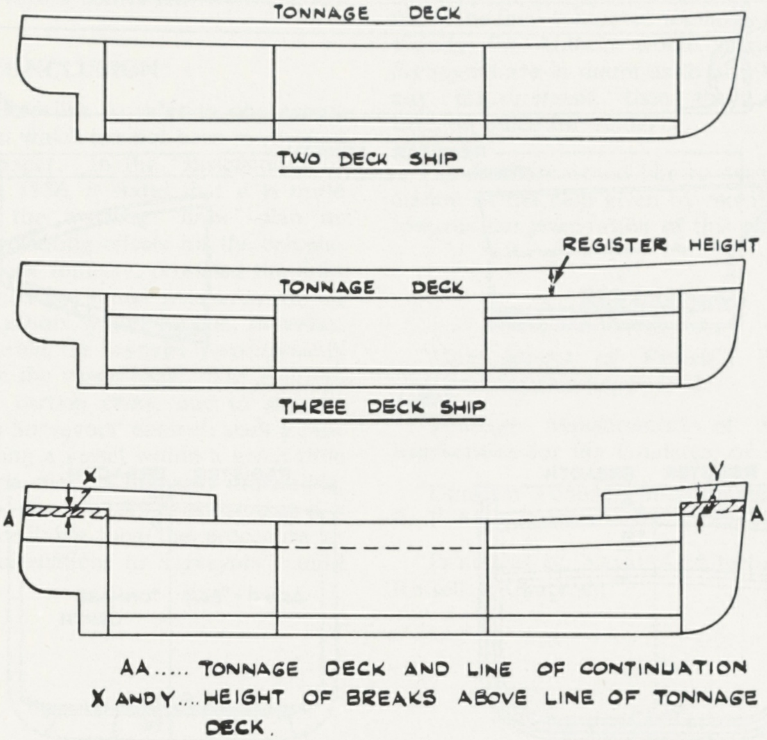

TONNAGE DECK
TWO DECK SHIP
REGISTER HEIGHT
TONNAGE DECK
THREE DECK SHIP
X
Y
A
A
AA..... TONNAGE DECK AND LINE OF CONTINUATION
X AND Y.... HEIGHT OF BREAKS ABOVE LINE OF TONNAGE DECK.

FIG. 3.

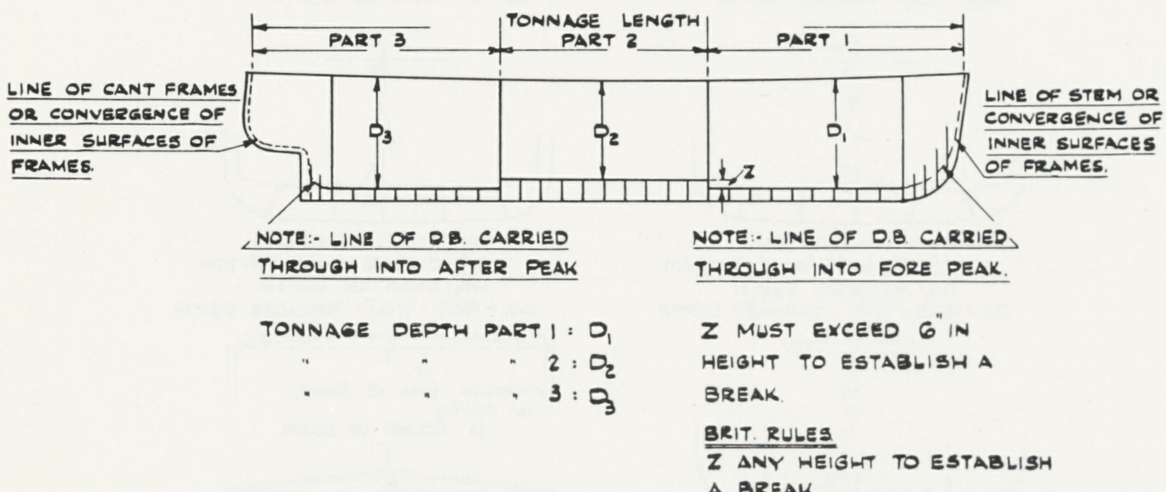
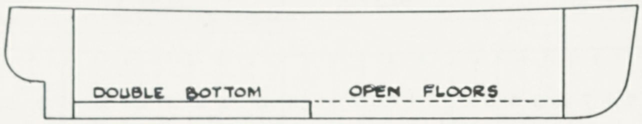
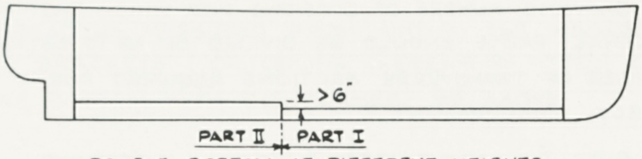

TONNAGE LENGTH
PART 3
PART 2
PART 1
LINE OF CANT FRAMES OR CONVERGENCE OF INNER SURFACES OF FRAMES.
LINE OF STEM OR CONVERGENCE OF INNER SURFACES OF FRAMES.
D3
D2
D1
Z
NOTE:- LINE OF D.B. CARRIED THROUGH INTO AFTER PEAK
NOTE:- LINE OF D.B. CARRIED THROUGH INTO FORE PEAK.
TONNAGE DEPTH PART 1 : D1
" " " 2 : D2
" " " 3 : D3
Z MUST EXCEED 6" IN HEIGHT TO ESTABLISH A BREAK.
BRIT. RULES
Z ANY HEIGHT TO ESTABLISH A BREAK.

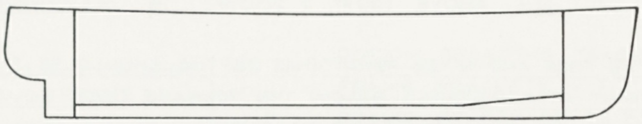
FIG. 4.



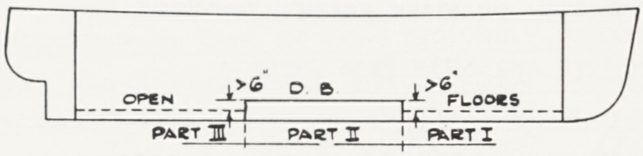
ORDINARY FLOORS AND DOUBLE BOTTOM AT SAME HEIGHT.... 1 PART.



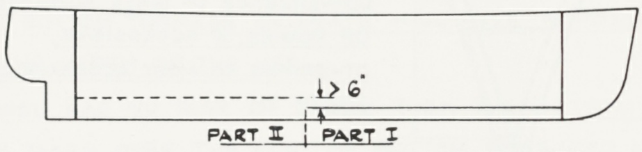
DOUBLE BOTTOM AT DIFFERENT HEIGHTS GREATER THAN 6".... 2 PARTS



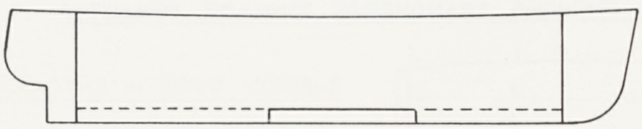
DOUBLE BOTTOM RISING AT FORE END .... 1 PART
RISING AT AFT END OR BOTH ENDS ..... 1 PART



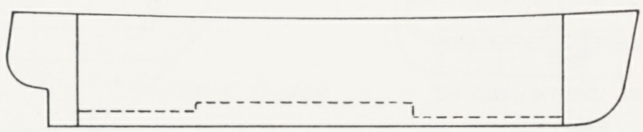
DOUBLE BOTTOM AMIDSHIPS EXCEEDING FLOORS BY MORE THAN 6"..... 3 PARTS



FLOORS EXCEEDING DOUBLE BOTTOM BY MORE THAN 6"..... 2 PARTS



DOUBLE BOTTOM AND FLOORS AT SAME HEIGHT.... 1 PART.

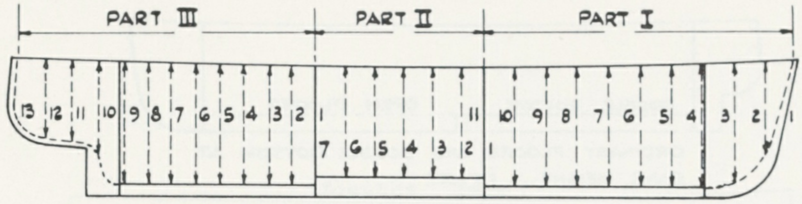


OPEN FLOORS THROUGHOUT.... ONE PART.

BRIT. RULES.-

ABOVE SKETCHES COMPLY WITH BRIT. RULES EXCEPT THAT A VERTICAL PLANE IS ESTABLISHED AT A BREAK OF ANY HEIGHT.

FIG. 5.

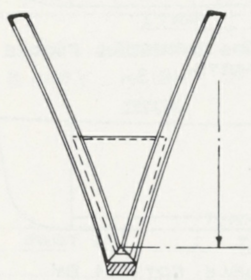


SKETCH SHOWING NUMBER OF DIVISIONS INTO WHICH THE LONGITUDINAL PARTS SHOULD BE DIVIDED SO AS TO ESTABLISH THE NUMBER OF TRANSVERSE SECTIONS REQUIRED FOR UNDERDECK MEASUREMENT.

PART	I :-	ABOVE 100 FT. $\ngtr$ 150 FT.	11 SECTIONS
"	II :-	50 FT. OR LESS	7 "
"	III :-	ABOVE 150 FT. $\ngtr$ 200 FT.	13 "

NOTE:- IN THE FORE AND AFTER PEAK TANKS DEPTHS SHOULD BE TAKEN FROM A POINT AT A DISTANCE BELOW THE TONNAGE DECK EQUAL TO 1/3 THE ROUND OR 1/2 THE PITCH OF BEAM DOWN TO THE IMAGINARY LINE OF THE DOUBLE BOTTOM TANK TOP OR FLOORS CARRIED THROUGH INTO THE PEAK TANKS AND RUNNING INTO THE LINE WHERE THE STEM OR STERN FRAMES CONVERGE.

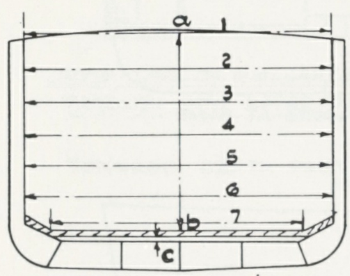
DEPTHS IN FORE AND AFTER PEAK TANKS.



DEPTHS TO BE TAKEN TO CONVERGENCE OF INNER SURFACES OF FRAMES, IF ACCESSIBLE, OTHERWISE TO MOST ACCESSIBLE DEPTH.

FIG. 6

SECTION SHOWING TRANSVERSE TONNAGE BREADTHS.



IN FIGURE TONNAGE DEPTH GREATER THAN 16 FT. GIVING RISE TO 7 BREADTHS.

TONNAGE DEPTH = ab + c

1. BOTTOM BREADTH IN FIG. TAKEN OVER FLAT OF WOOD SHEATHING.
2. IF NO WOOD SHEATHING FITTED, BOTTOM BREADTH TAKEN OVER FLAT OF DOUBLE BOTTOM.

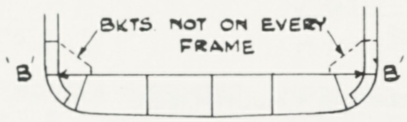
FIG. 7.

RISE OR FALL OF DOUBLE BOTTOM.

BOTTOM BREADTHS MEASURED FROM AND TO THE INBOARD END OF THE FRAME BRACKETS (OR CEILING THEREON IF FITTED) CONNECTING THE DOUBLE BOTTOM WITH THE FRAMES. 'BB' ABOVE.

FIG. 8

FRAME BRACKETS.



BOTTOM BREADTHS TAKEN TO TOES OF FRAME BRACKETS IF FITTED ON EVERY FRAME OTHERWISE TO BE TAKEN TO LINE OF FRAME i.e. 'BB'.

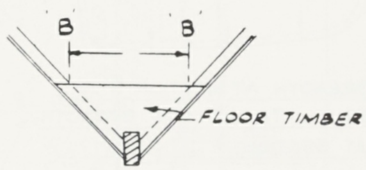
BOTTOM BREADTHS IN CASE OF LONGITUDINALLY FRAMED VESSELS.

IF THE VESSEL HAS A MEASURABLE RISE OF FLOOR AND IF THE TOPS OF THE BOTTOM LONGITUDINALS ARE OF UNIFORM HEIGHT, THEN THE LOWEST TONNAGE BREADTH COULD BE ZERO. AS HOWEVER IT USUALLY HAPPENS THAT THERE IS NO RISE OF FLOOR FOR THE WIDTH OF THE KEEL PLATE, THE BOTTOM TONNAGE ORDINATE WILL HAVE A POSITIVE VALUE EQUAL TO THE WIDTH OF THE KEEL.

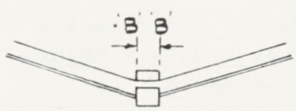
IF THE VESSEL HAS NO RISE OF FLOOR THEN THE BOTTOM TONNAGE BREADTH IS TAKEN OVER THE FLAT OF BOTTOM MEASURED AT THE TOPS OF THE LONGITUDINALS.

FIG. 9

BOTTOM BREADTHS IN WOOD VESSELS.



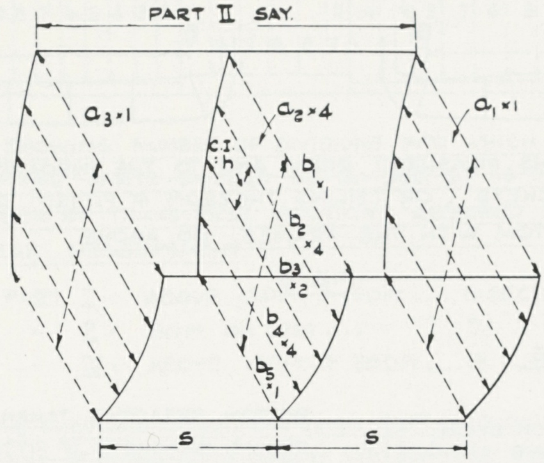
BOTTOM BREADTH TAKEN OVER FLAT OF FLOOR.



BOTTOM BREADTH EQUAL TO THE BREADTH OF KEELSON.

FIG. 10.

SKETCH SHEWING TRANSVERSE SECTIONS USED FOR ASCERTAINING UNDERDECK TONNAGE.



AREA SECTION = a_1 ; a_2 ; OR a_3 = $\frac{1}{3}h \sum$ BREADTHS × MULTIPLIERS.

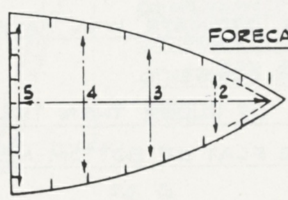
VOLUME PART II = $\frac{1}{3} S \sum$ AREAS OF SECTIONS × MULTIPLIERS = V SAY.

TONNAGE PART II = $\frac{V}{100}$ TONNAGE TONS.

FIG. 11.

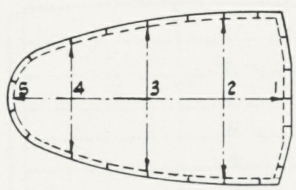
SUPERSTRUCTURES.

LENGTH AND BREADTHS TO BE MEASURED AT HALF-HEIGHT OF ERECTION.



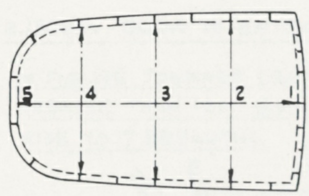
FORECASTLE

POOP



BREADTH AT SECTION 5 TO EQUAL ONE-HALF BREADTH AT SECTION 4.

BREADTH AT SECTION 1 TO EQUAL TWO-THIRDS BREADTH AT SECTION 2.



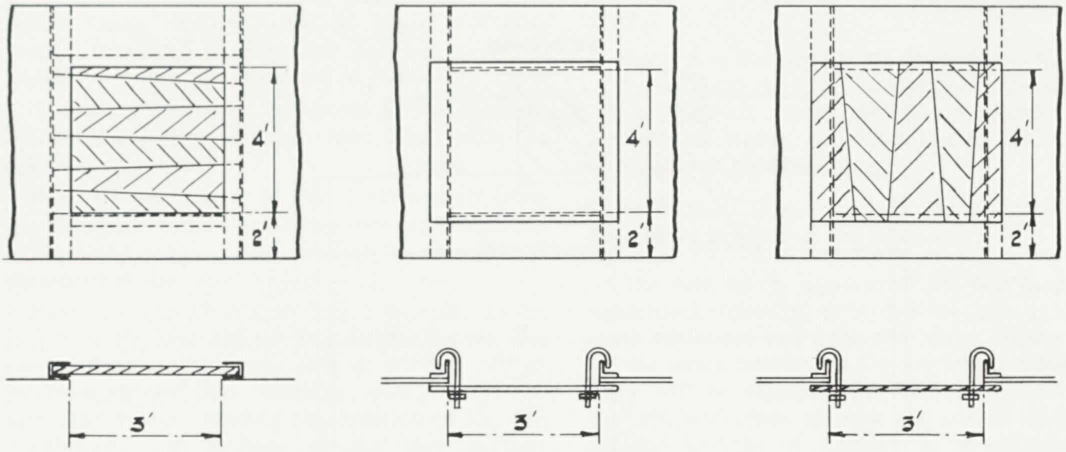
BREADTH AT SECTION 5 TO EQUAL TWO-THIRDS BREADTH AT SECTION 4.

BREADTH AT SECTION 1 TO EQUAL ONE-HALF BREADTH AT SECTION 2.

FIG. 12.

TONNAGE OPENING CLOSURES.

BULKHEAD OPENINGS.



SHIFTING BOARDS SUPPORTED IN CHANNELS.

HOOK BOLTED PLATE. BOLTS SPACED NOT LESS THAN 12" APART.

BOARDS HELD IN PLACE BY HOOK BOLTS SPACED NOT LESS THAN 12" APART.

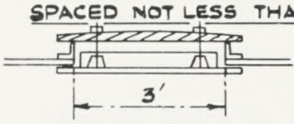


PLATE OR BOARDS HELD IN POSITION BY BOLTED CROSSPIECES.

NOTE :-

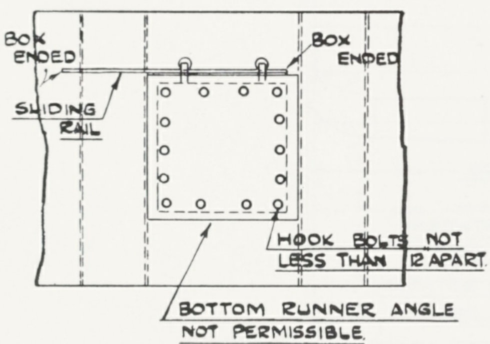
(i) BOLTS MUST NOT PASS THROUGH THE BULKHEAD.

(ii) COVER PLATES MUST FAY AGAINST THE BULKHEAD.

UNDER U.S. REGULATIONS PLATES ARE NOT ALLOWED IN SHELTER TWEEN DECK BULKHEADS AS A MEANS OF CLOSING TONNAGE OPENINGS.

SLIDING STEEL COVERS.

THE FOLLOWING MEANS FOR CLOSING TONNAGE OPENINGS IN BULKHEADS HAS BEEN APPROVED.



SHELTER DECK TONNAGE OPENING.

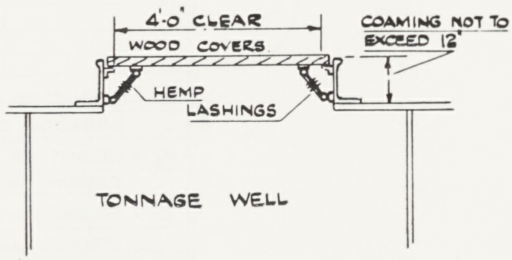
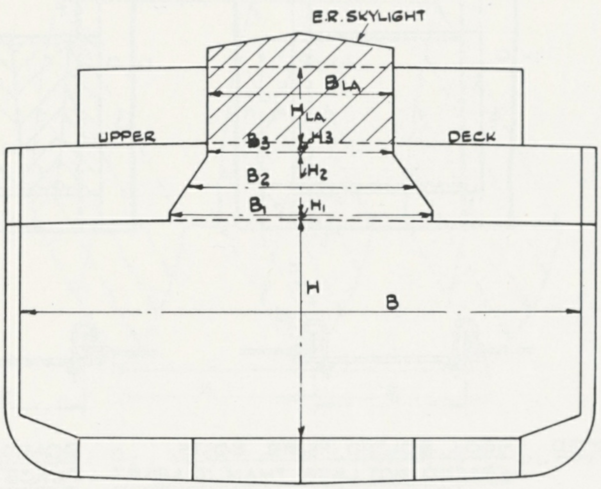


FIG. 13.

ENGINE ROOM MEASUREMENT.



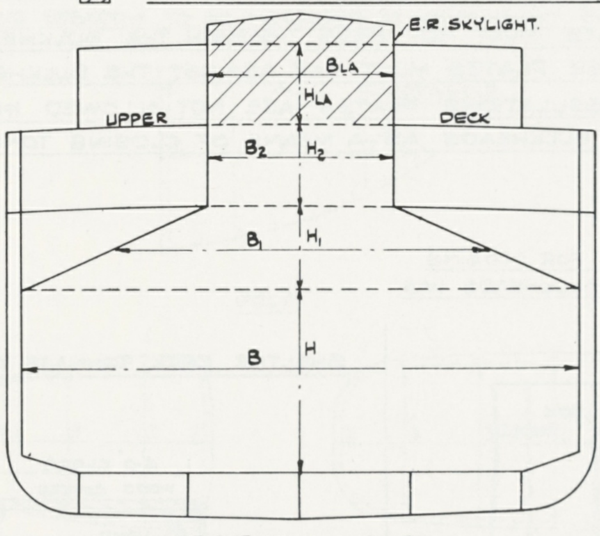
H : HEIGHT OF MAIN SPACE.

B : BREADTH OF " " .

$H_1 + H_2 + H_3$: HEIGHT OF SPACE BETWEEN CROWN AND UPPER DECK.

B_1 ; B_2 + B_3 : BREADTHS OF SPACE BETWEEN CROWN AND UPPER DECK.

▨ : LIGHT AND AIR SPACES ABOVE UPPER DK.



$H + H_1$: HEIGHT OF MAIN SPACE.

$B + B_1$: BREADTHS OF " " .

H_2 : HEIGHT OF SPACE BETWEEN CROWN AND UPPER DECK.

B_2 : BREADTH OF SPACE BETWEEN CROWN AND UPPER DECK.

▨ : LIGHT AND AIR SPACES ABOVE UPPER DK.

FIG. 14.

APPENDIX II

1. Measurement of a Vessel Having Side Tanks

Consider a vessel (Fig. 15) having side tanks above the floor line or double bottom and through which tanks tonnage breadths would normally pass if measured in the usual way. A vessel so constructed may be measured in parts.

The case considered, as shown in the diagram below, has been divided into five parts as follows: —

Part 1.—The length of Part 1 extends aft from the fore-end to the line of the forward bulkheads of the side tanks. The tonnage of this part is measured in the usual way.

Part 2.—The length of Part 2 is equal to the length of the side tanks. The depths for tonnage measurement in this case extend, at their proper intervals under the tonnage deck, down to athwartship lines forming continuation of the side tank tops. The tonnage of the part is then measured in the usual way.

Part 3.—The length of Part 3 equals the length of Part 2. The breadths for Part 3 are taken between the inboard faces of the side tank bulkheads and the depths from athwartship lines forming continuation of the side tank tops. The tonnage of the part is then measured in the usual way.

Part 4.—The length of Part 4 extends from a line athwart the after bulkhead of the side tanks to a point aft where the tonnage length would usually terminate. The tonnage of this part is measured in the usual way.

Part 5.—The side tanks. The tonnage of the side tanks is found in the usual way.

The sum of the tonnage of the five parts is the underdeck tonnage, provided the side tanks and peak tanks are not *bona fide* water ballast tanks. If the tanks mentioned are for water ballast only they will be exempt from tonnage measurement and the underdeck tonnage will consist of the sum of the tonnage of Parts 1 to 4 excluding the tonnage of the peak tanks.

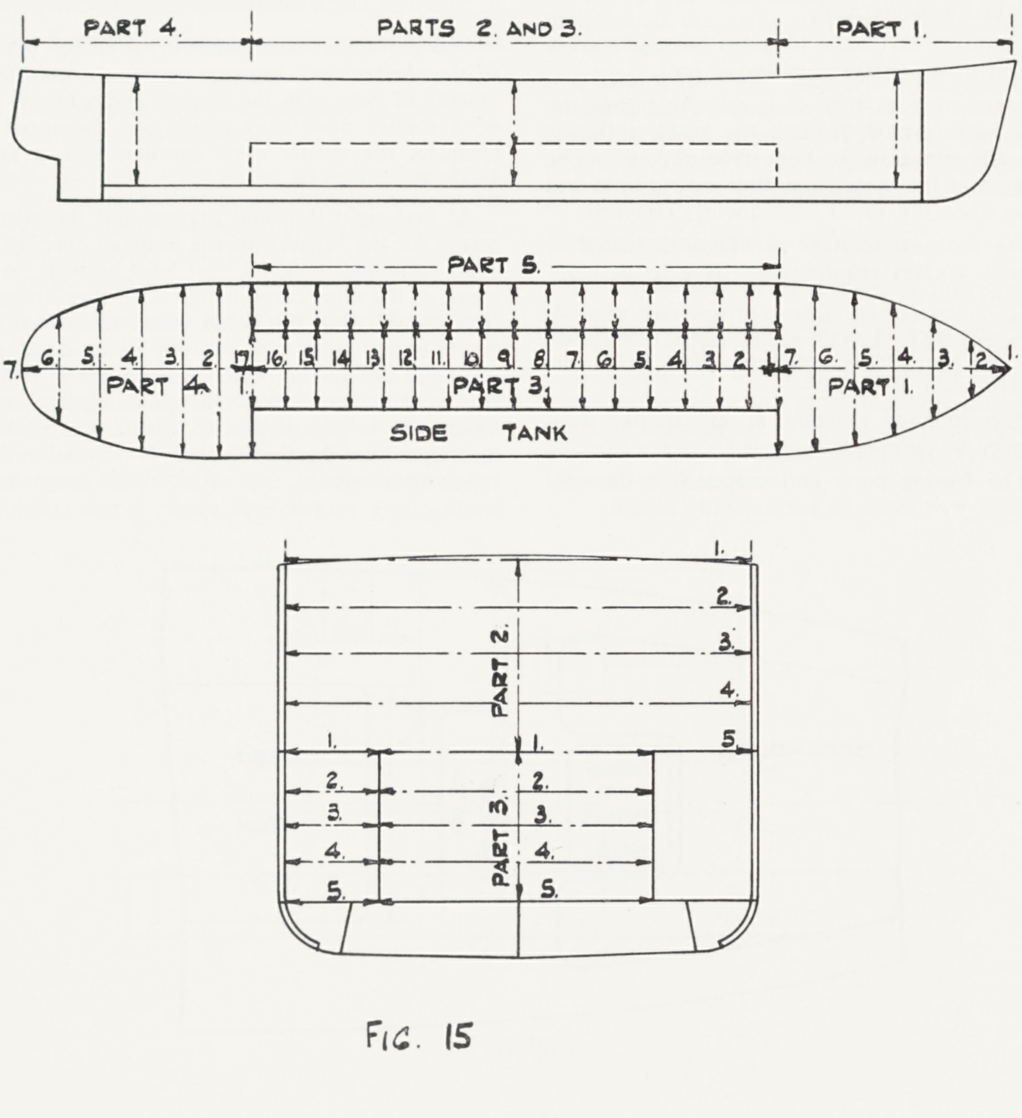


FIG. 15

2. Shelter Deck Ships

In recent years the shelter deck type of ship has become very popular and it is thought the following notes about the measurement of this type of vessel would not be amiss.

Two measurements are usually made when measuring a shelter deck ship for tonnage, one for the open and one for the closed condition, each condition being treated as an individual vessel, measured as such, and measurements entered on the T 1 and T 2 tonnage forms in the usual manner. It is contrary to the tonnage regulations for only one measurement to be made, the remaining condition being ascertained from the measured condition by making the necessary allowances for the change in tonnage deck.

The two measurements are made while the vessel is building in order that the tonnages for the two conditions may be calculated so that, in the event of the vessel changing from one condition to the other, the appropriate tonnage figures will be available and new tonnage certificates can be issued with the shortest possible delay, after checking that no changes have taken place since the original measurement.

The tonnage certificate issued is the one for the condition in which the ship leaves port.

In cases such as this, it is advisable that the owners be informed through the builders that it will be advantageous for both measurements to be completed at the same time, thus saving time and expense when the vessel subsequently converts.

Before the new tonnage certificate is issued to the vessel, certain requirements have to be complied with.

First, consider an open shelter deck vessel converting to the closed condition, then from the freeboard point of view:—

(i) The tonnage opening in the shelter deck must be permanently closed.

(ii) The freeing ports and scuppers in the tonnage well must be permanently closed.

Second, consider a closed shelter deck vessel reverting to the open condition, then from the tonnage point of view:—

(i) The tonnage opening in the shelter deck must be restored.

Note.—If the maximum draught in the open condition is required, then the shelter deck tonnage opening and the tonnage openings in the well bulkheads must be fitted with temporary closing appliances. Temporary closing appliances may also be required on the remaining shelter 'tween deck bulkheads in order to satisfy safety equipment requirements.

An overboard scupper not less than 5 in. in diameter must be fitted on each side of the tonnage well with a screw down automatic non-return valve controlled from the shelter deck, having an indicator showing whether the valve is open or shut.

Other requirements from the load line point of view may also have to be complied with. Particulars of these are usually forwarded from London office.

3. Shelter Deck Opening

One particular case which involved the breadth of the shelter deck tonnage opening is considered worthy of note. On the general arrangement plan of a shelter deck ship which was measured for tonnage, the shelter deck opening was arranged as shown in Fig. 16.

At first sight it would appear that the requirements for the breadth of the tonnage opening had been complied with, i.e., "at least as wide, in the clear, as the after cargo hatch". Further investigation showed that the cargo hatch concerned (i.e., No. 6 hatch) gave access to the 'tween deck space only and not to the hold. The official interpretation in this instance was that the hatch in question could only be regarded as an auxiliary cargo hatch and since the hatch referred to in the tonnage regulations means the after main cargo hatch leading to a proper hold space, it was considered

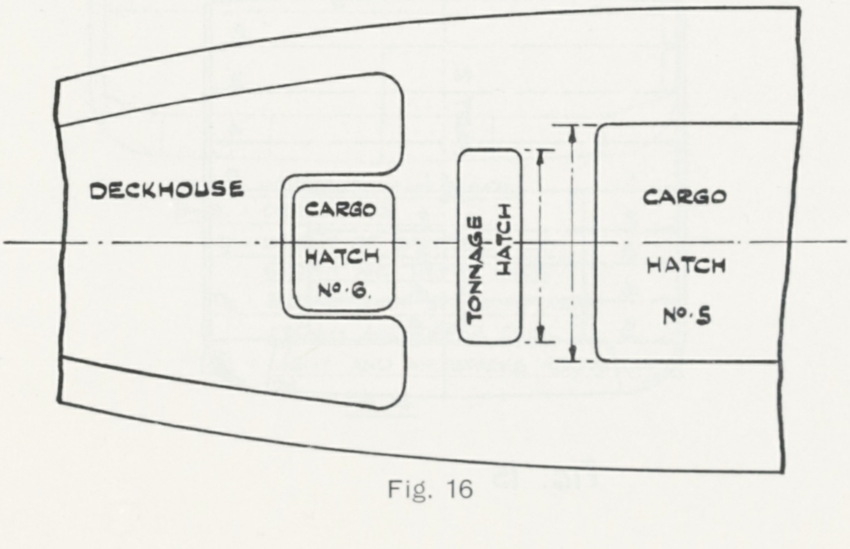


Fig. 16

that the arrangement shown did not comply with the tonnage regulations, and hence the tonnage opening should be increased accordingly to the width of No. 5 after main cargo hatch.

4. Water Ballast and Void Space

The following case was submitted by an owner who requested guidance on how to treat wing tanks in a tanker fitted out as described below:—

(i) Suction and stripper lines blanked off.

(ii) Bilge eductor fitted and operated by hose from Butterworth and firemain.

(iii) No heating coils were fitted.

The first point raised by the owner was whether the tanks concerned could be considered as being void spaces and if so, whether they were entitled to exemption from the gross tonnage. The second point was, if the tanks were fitted by means of a portable hose connected to the ballast and firemain system with the hose passing through a manhole in the deck, could the tanks be treated as *bona fide* water ballast tanks and hence be exempted from the gross tonnage.

The decisions reached in this case were as follows:—

(i) Void spaces must be included in the gross tonnage measurement.

(ii) If the tanks were to be considered as *bona fide* water ballast tanks, then there must be a permanent connection to the ballast system for emptying and filling the tanks and the cargo lines must be disconnected.

This case illustrates the importance of forwarding the fullest information with the tonnage measurement to ensure that exemption from the gross tonnage is justified. In this respect it is advisable to ensure personally that such spaces are fitted for water ballast only and not to accept a statement that this is so. In many instances time would be saved if it was stated on the T 2 form that the spaces claimed as water ballast exemptions qualified as such under the U.S. Tonnage Regulations.

If any doubt exists, the London office Staff will be only too willing to help.

5. Companions

Companions or booby hatches serving as a protection for companionways (stairways or ladderways) leading to spaces below are exempt from tonnage measurement.

Consider the arrangements as shown in Fig. 17.

For the purpose of tonnage measurement, the space "efgh" is treated as an exempt space and hence is not included in the gross tonnage. The space"ehj" is measured and included as part of the crew passageways and, although initially included in the gross tonnage, is allowed as part of the crew space deduction when ascertaining the net tonnage.

The space "ejk", if boxed-in or adapted as a small cupboard for medicine, linen, mops, etc., is included in the gross tonnage without allowance of any kind.

If this space "ejk" was left open, however, it would then be considered as being part of the space in which it was centred (e.g., passageway, cabin, etc.) and allowed as part of the crew space deductions when ascertaining the net tonnage.

6. Waterclosets

With reference to para. 13(*f*) of this paper it is thought that the following diagrams may help to clarify which spaces can be treated as waterclosets.

It should be noted that to merit exemption from inclusion in the gross tonnage, such spaces must be situated on or above the upper deck. If situated below the upper deck then they would be allowed as deductions.

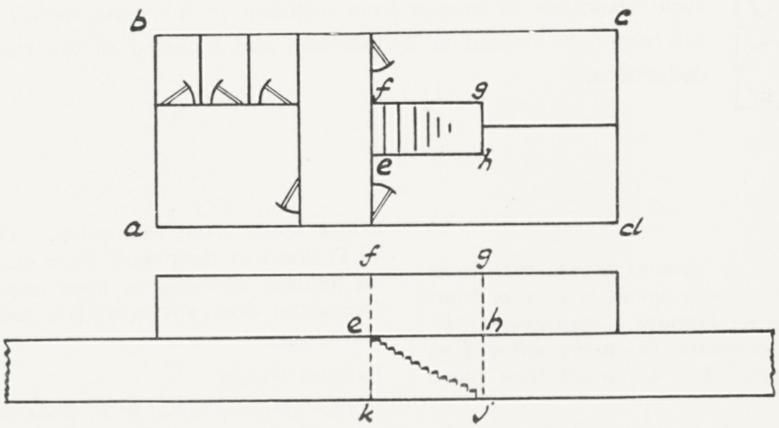


Fig. 17

The compartments shown in the following diagrams are considered public compartments, i.e., available for the use of more than one person.

Compartments arranged or similarly arranged as shown in diagrams Figs. 18—20 are considered as being waterclosets and hence would be exempted from inclusion in the gross tonnage measurement.

Consider now a compartment arranged as shown in Fig. 21 and again available for the use of more than one person.

Consider finally, a compartment containing a bath and a w.c. as shown in Fig. 22.

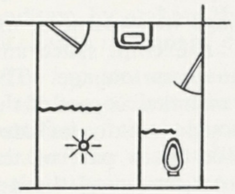


FIG. 18

Combined shr, and w.c. with w.c. open to or curtained off from rest of compartment.

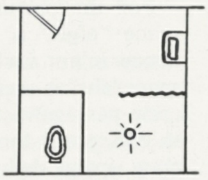


FIG. 19

Combined shr. and w.c. with w.c. bulkheaded off from rest of compartment.

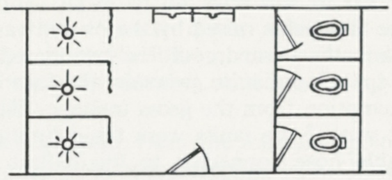


FIG. 20

Combined shrs., w.c.'s and urinals.

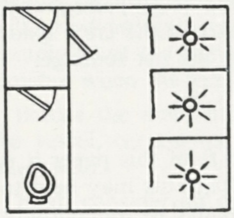


FIG. 21

This space would be treated as follows:—

w.c.	Exempt from inclusion in the gross tonnage measurement.
Shrs.	Deducted as part of the crew spaces.
Lobby	Deducted as part of the crew spaces.

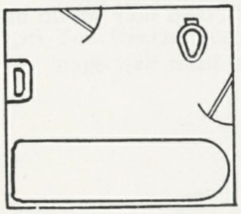


FIG. 22

In this instance, due to the inclusion of a tub or bath, the compartment is considered as being a bathroom irrespective of the presence of the w.c. and as such would not be exempt from inclusion in the gross tonnage measurement but would be treated as a deduction and included in the main crew space deductions.

BRITISH RULES

In Figs. 18—21, as shown above, the space occupied by the w.c.'s only would be exempt from inclusion in the gross tonnage measurement, the remainder of the compartment being allowed as deductions and included in the main crew space deductions.

In Fig. 22, due to the presence of the w.c., the compartment would be considered as being a watercloset space and as such would be exempt from inclusion in the gross tonnage measurement.

7. W.T. DOORS AND BRIDGE AND FORECASTLE BULKHEADS

Consider the arrangement as shown in the following diagrams of Fig. 23.

Irrespective of the presence of a W.T. door or doors in the aft end bulkhead of a bridge or forecastle, provided tonnage openings are fitted in accordance with the regulations, the bridge or forecastle would still be treated as an open superstructure and the relevant part exempted from inclusion in the gross tonnage measurement. It should be noted that the presence of the W.T. doors in the bridge front does not invalidate the bridge space from exemption. The presence of W.T. doors in temporary plate closing appliances on tonnage openings of open poops, bridges and forecastles does not invalidate such spaces from exemption.

BRITISH RULES

The presence of a W.T. door or doors in the same bulkhead as the tonnage openings would invalidate a space as being treated as an open superstructure and hence would not be exempted from inclusion in the gross tonnage measurement.

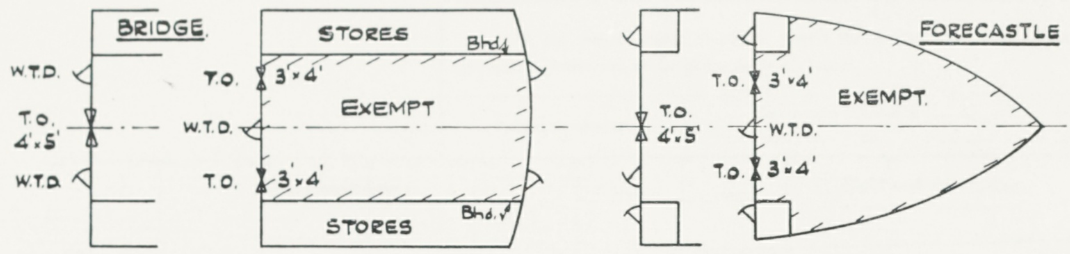


Fig. 23

W.T. doors are not permitted in temporary plate closing appliances on tonnage openings.

8. Engine Room Deductions

In paragraph 25(*f*) it is stated that to ascertain the net engine room tonnage, all spaces occupied by auxiliary machinery not used in connection with propelling the vessel must be deducted from the gross engine room tonnage. In all cases it is advisable to consult our engineering colleagues as to which items of auxiliary machinery come into the above category.

The following list is given as a guide:—

Electricians' stores
Lubricating oil storage tanks
Diesel oil storage tanks
Butterworth heater
Oil drain tanks
Fresh water tanks
Sanitary water tanks
Spare shaft
Calorifiers
Oily water separator
Generators (if not used in connection with main engine and its auxiliaries)
Ship's service air compressor
Cargo oil pumps

APPENDIX 3

Examples

Fig. 24 shows an outline general arrangement of the example chosen, and the profile above indicates the division of length for the underdeck measurement and the point to which the depth is measured at each ordinate. (Note particularly the depth of ordinates within the peaks)

Fig. 25 shows the tonnage computation on forms T 1 and T 2 for the vessel shown in Fig. 24. Bearing in mind the possibility of future modifications to the vessel, which may be carried out at a port other than that where the vessel was built, it would be an obvious advantage if a standard layout of computations existed throughout the Society. It is, therefore, suggested that the method as shown in Fig. 25 be applied as far as possible to all computations.

Fig. 26 shows a specimen tonnage certificate embodying the tonnages from Fig. 25.

As already mentioned, it is advisable to forward the underdeck measurement on form T 1 to London office as soon as possible and not to hold it pending completion of the measurement of erections, exemptions and deductions. Again, where time does not permit the working out of the computation, if the measurements are forwarded on the prescribed forms, the final tonnages are computed in London.

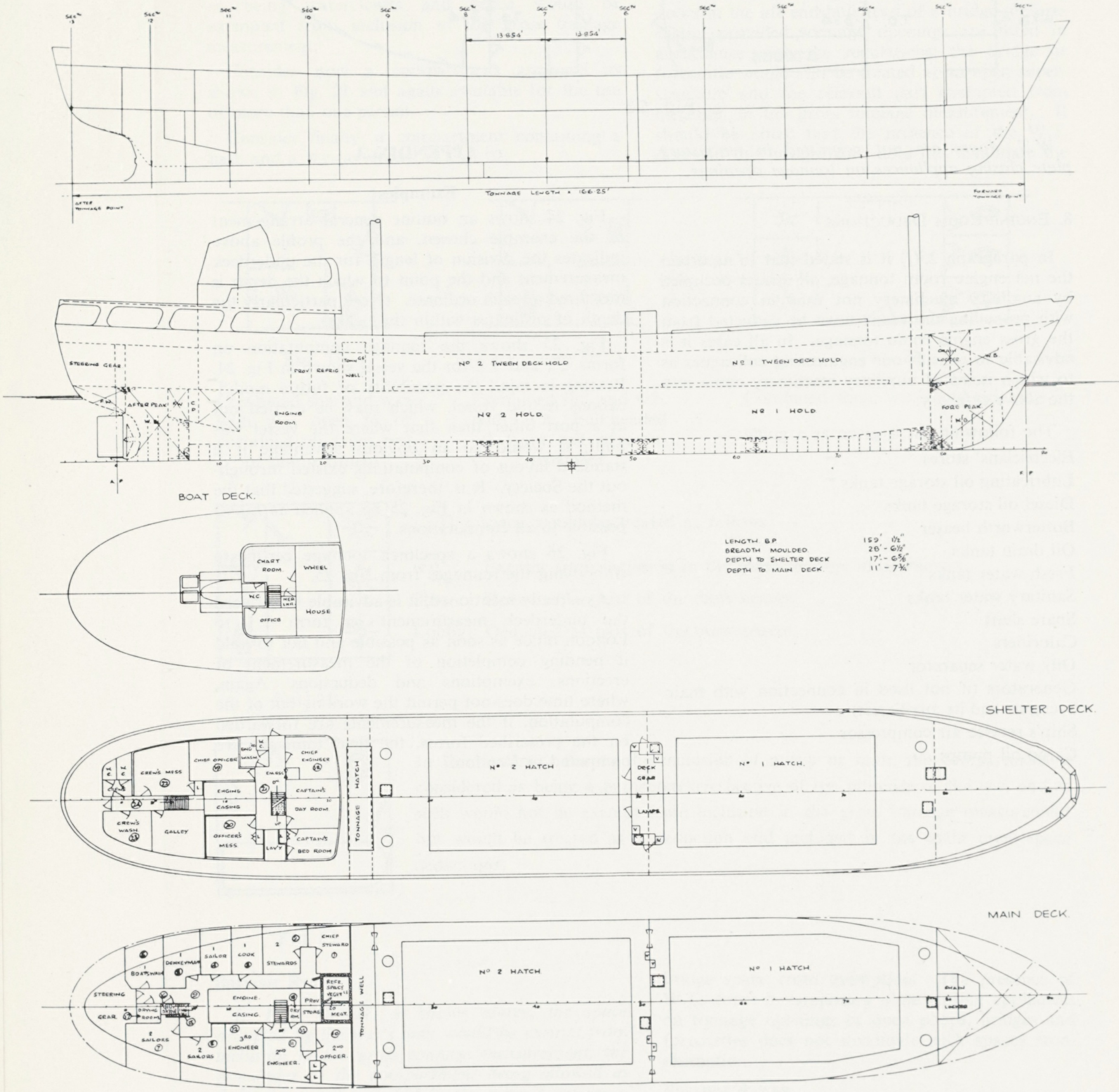

TONNAGE LENGTH = 106·25'
13·854'
13·854'
AFTER TONNAGE POINT
FORWARD TONNAGE POINT
STEERING GEAR
Nº 2 TWEEN DECK HOLD
Nº 1 TWEEN DECK HOLD
AFTER PEAK
ENGINE ROOM
Nº 2 HOLD
Nº 1 HOLD
FORE PEAK
BOAT DECK.
CHART ROOM
WHEEL HOUSE
OFFICE
LENGTH B.P. 159' 1½"
BREADTH MOULDED 28' - 6½"
DEPTH TO SHELTER DECK 17' - 6⅝"
DEPTH TO MAIN DECK 11' - 7¾"
SHELTER DECK.
CREW'S MESS
CHIEF OFFICER
CHIEF ENGINEER
ENGINE CASING
CAPTAIN'S DAY ROOM
CREW'S WASH
GALLEY
OFFICERS MESS
CAPTAIN'S BED ROOM
TONNAGE HATCH
Nº 2 HATCH
DECK GEAR
LAMPS
Nº 1 HATCH
MAIN DECK.
BOATSWAIN
DONKEYMAN
SAILOR
COOK
STEWARDS
CHIEF STEWARD
STEERING GEAR
ENGINE CASING
PROV STORE
2 SAILORS
3RD ENGINEER
2ND ENGINEER
2ND OFFICER
TONNAGE WELL
Nº 2 HATCH
Nº 1 HATCH

Fig. 24

In the case of steam or motor vessels the engine room measurements and the calc
propelling power are to be given in detail below.

Position of engine room :—	Engine room bulkhead is 5.31 feet (forward) (aft) of Boiler do. do. „ (forward) (aft) ..„

Machinery Spaces

MOTOR ROOM 27.0

Sect: 1			Sect: 2		
29.08	1	29.08	21.98	1	21.98
27.19	4	108.76	20.52	4	82.08
24.35	2	48.70	18.34	2	36.68
20.68	4	82.72	15.52	4	62.08
15.93	1	15.93	11.87	1	11.87
		285.19			214.69
		0.73			0.75
		208.19			161.02

Sect: 3					
14.59	1	14.59			
12.02	4	48.08			
9.17	2	18.34			
6.56	4	26.24	208.19	1	208.19
4.21	1	4.21	161.02	4	644.08
		111.46	85.82	1	85.82
		0.77			938.09
		85.82		$\frac{13.5}{3}$ =	4.50
					42.21

42.21

Less Auxiliaries

Refrig. Compressor	3.5 x 1.42 x 2.25 = 0.11	
Refrig. Cool Water Pump	2.0 x 1.00 x 0.83 = 0.02	
Storage Tank	2.25 x 1.00 x 1.00 = 0.02	
Storage Tank	2.25 x 1.00 x 1.00 = 0.02	0.92
Generator	5.00 x 2.30 x 4.00 = 0.46	
Storage Tank	2.5 x 1.5 x 2.0 = 0.08	
Switchboard	½ x 6.5 x 6.5 x 1.0 = 0.21	
		41.29

Settling Tanks

2 x 7.2 x 3.2 x 5.2 = 2.40 tons

less than 1% of 404.34

Light and Air Spaces 9.98

51.27

$\frac{51.27 \times 100}{404.34}$ = 12.68% Gross

less than 13% Gross

P.P. allowance $\frac{32}{13}$ x 51.27 = 126.20

Light and Air Spaces

In Shelterdeck

Motor Casing 1.50 x 2.94, 10.30 x 5.88 } x 7.40 = 4.81

2nd Tier

Motor Casing 9.15 x 5.88 x 6.90 = 3.71

3rd Tier

Raised Casing 7.30 x 5.88 x 3.40 = 1.46

9.98

Hatchways

No.1 in Shelterdeck 11.34 x 19.61, 28.27 x 21.80 } x 0.60 = 5.03

No.2 in Shelterdeck 39.60 x 21.80 x 0.60 = 5.18

Small Hatches

2 @ 1.71 x 1.875 x 0.75 = 0.05

1 @ 1.81 x 2.375 x 0.75 = 0.03

1 @ 1.60 x 2.375 x 0.75 = 0.03

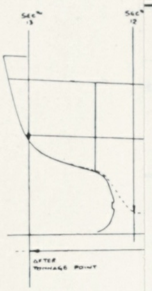
10.32

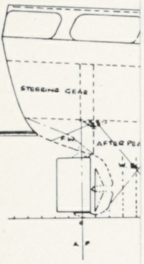
½% Gross ex Hatches 1.98

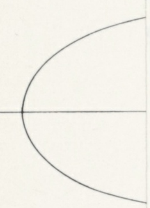
8.34

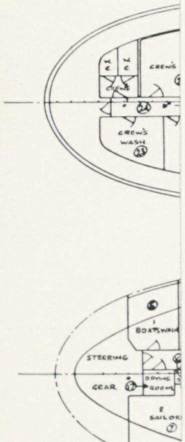
Fig. 25

ulations for the allowance for	Register Dimensions		
	Length	Breadth	Depth
area 10 "	159.45	28.66	8.77









Erections (*Contd.*)

Carried Forward 46.88

Chart House 3rd Tier

2.10 x 10.85 } x 7.70 = 5.21
6.90 x 6.50 }

Plus

Med.Lkr. 2.10 x 2.00 x 7.70 = 0.32

47.20

Exempted Spaces (cont'd.)

Steering Gear 1.81 x 5.93 x 7.40

8.50 x {18.40, 12.55, 0} x 7.51 — 8.09

Exempted Spaces

Fore Peak Tank Below 7.00

Fore Peak Tank in Shelterdeck

16.22 x {0, 13.54, 19.48} x 9.18 = 18.25

25.25

Less Chain Locker

3.60 x 6.40 } x 9.13 = 4.70
3.60 x 7.91 }

20.55

Aft Peak Tank 6.00

Less F.W.T.

3.60 x 12.00 x 5.0 = 2.16 — 3.84

Open Shelter Deck

102.60 {19.12, 24.94, 27.00, 27.06, 27.12, 27.16, 27.16, 27.30, 27.40} 7.11 (mean) — 193.21

Less No.1 Hatch area x 0.50 = 4.19 } 8.50
No.2 Hatch area x 0.50 = 4.31 }

184.71

Stairways

In Masthouse 2 x 3.80 x 1.70 x 6.39 = 0.83
In R.H. 2nd Tier Aft 2.00 x 2.00 x 6.90 = 0.28
In R.H. 2nd Tier Aft ½ x 2.60 x 4.00 x 6.90 = 0.36
In R.H. 2nd Tier Aft 7.20 x 2.30 x 6.90 = 1.24
3rd Tier 2.40 x 4.40 x 7.70 = 0.81 — 3.52

Galley

9.20 {8.30, 7.75, 7.00} x 6.90 — 4.89

Vents

In Masthouse 4 x 1.00 x 1.50 x 6.39 — 0.38

Wheelhouse 8.00 x 15.80 x 7.70 — 9.73

W.C.'s

In R.H. 2nd Tier Aft 5.50 x 5.20 x 6.90 = 1.97
In R.H. 2nd Tier Aft 4.60 x 6.10 x 6.90 = 1.94
3rd Tier 4.20 x 4.20 x 7.70 = 1.36 — 5.27

Chain Locker 3.60 x 6.40 } x 9.13 — 4.70
3.60 x 7.91 }

—cont.

WATER CLOSETS					
For whom	Situation	Lighting	Ventilation	How drained	No. of Seats

Are they fitted with flushing arrangements ?

Are the Crew Spaces fitted with heating arrangements ?

Are they protected from effluvium ?

Are those on the weather deck properly constructed, secured and drained ?

SUMMARY (Navigating Spaces)	TONS
Master's Accommodation	9.77
Chart Space	4.89
Wireless Telegraphy Space ...	
Battery Room	
Boatswain's Store ... 1%	4.04
Ballast Pump Spaces	
Dynamo Spaces	
Steering Gear Spaces	
Sail Room	
Chain Locker (below deck) ...	
Gyro Room	
TOTAL ...	18.70

On the .... day of .... 195...., I completed the inspection and measurement of the spaces mentioned hereon and hereby certify that they fully comply with the provisions of the recognised Crew Space Standards.

.... *Surveyor*

.... *Port* .... *Date*

Fig. 25—cont.

CALCULATIONS for the Spaces allowed under the Tonnage Regulations, exclusive of Crew Space, stating where each Space is situated and whether above or below deck.

WATER BALLAST SPACES

Description :—		Fore Peak Tank								After Peak Tank									
Area 1				Area 2		Area 3		Area		Area 1		Area 2		Area 3		Area		Area	
Depths ...				6.20		7.50				9.40		8.00		3.20					
Com. int. bet. bths.				1.550		1.875				2.35				0.80					
No. of bths.	Multipliers	Bths.	Products	Bths.	Products	Bths.	Products	Bths.	Products	Bths.	Products	Bths.	Products	Bths.	Products	Bths.	Products	Bths.	Products
1	1			9.05	9.05	16.20	16.20			19.60	19.60			13.20	13.20				
2	4			7.52	30.08	14.56	58.24			13.30	53.20	see area 12		11.00	44.00				
3	2			6.18	12.36	13.00	26.00			7.80	15.60	of Underdeck		8.55	17.10				
4	4			4.90	19.60	11.30	45.20			4.60	18.40	Tonnage		5.80	23.20				
5	2			3.50	3.50	9.50	9.50			2.85	2.85			3.20	3.20				
6	4																		
7	1																		
⅓ com. int. bet. bths.					74.59 0.52		155.14 0.63				109.65 0.78				100.70 0.27				
					38.787		97.738				85.527		55.154		27.189				

All measurements to be in feet and decimals of a foot

Fore Peak Tank

Mean Length	16.60		
Com. int. bet. areas	8.30		
No. of areas	Multipliers	Areas	Products
1	1	0	0
2	4	38.787	155.148
3	1	97.738	97.738
			252.886
⅓ com. int. bet. areas			2.767
			7.00

After Peak Tank

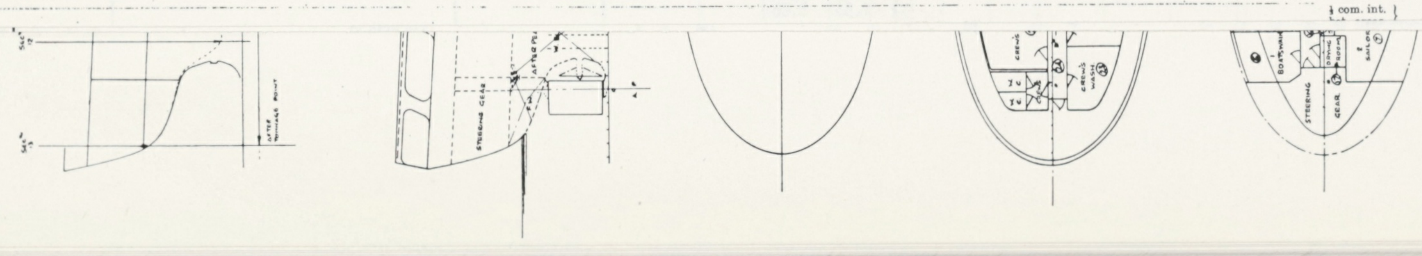
Mean Length	10.80		
Com. int. bet. areas	5.40		
No. of areas	Multipliers	Areas	Products
1	1	85.527	85.527
2	4	55.154	220.616
3	1	27.189	27.189
			333.332
⅓ com. int. bet. areas			1.80
			6.00

Mean Length			
Com. int. bet. areas			
No. of areas	Multipliers	Areas	Products
1	1		
2	4		
3	1		
⅓ com. int. bet. areas			

DETAILS OF NAVIGATING SPACES

	L. B. D.	TONS
Captain's Dayroom	9.00 x 8.50 x 6.90	5.28
Captain's Bedroom	8.40 x 5.25 x 6.90	3.04
Captain's Lavatory	4.00 x 5.25 x 6.90	1.45
		9.77
Chart Room	2.10 x 10.85 x 7.70	5.21
	6.90 x 6.50	
Less Medical Locker	2.10 x 2.00 x 7.70	- 0.32
		4.89
In Masthouse: Lamps and Store	4.88 x 17.20 x 6.39	5.36
Less		
4 Vents	4 x 1.00 x 1.50 x 6.39 = 0.38	- 1.21
2 Staircases	2 x 3.80 x 1.70 x 6.39 = 0.83	
		4.15

After Peak Tank		6.00
less F.W.T.		
3.60 x 12.00 x 500		2.16
		3.84



LLOYD'S REGISTER OF SHIPPING

REPRESENTATIVES FOR

THE REPUBLIC OF LIBERIA

Certificate No. 00000 Port of LONDON

30th June, 1958

CERTIFICATE OF MEASUREMENT

This is to certify that a measurement has been made of the[1] LIBERIAN MOTOR SCREW called the "PSEUDONYM" of MONROVIA, official number 0000, which was built by LLOYDS in the year 1958, at LONDON ENGLAND, of STEEL; and has been known as builder's hull No. 1; that she has ONE deck, SHELTERDECK TWO masts, RAKED stem, and CRUISER stern; that her register length is 159.45 feet, her register breadth is 28.66 feet, her register depth is 8.77 feet, her height under upper deck is[2] – feet, and that her tonnage is as follows:

	TONS	100ths
Capacity under tonnage deck[3]	268	34
Capacity between decks, above tonnage deck	65	59
Capacity of enclosures on the upper deck, viz:		
Forecastle[4] –, bridge –, poop –, break –,		
deckhouses 47.20, side houses –, charthouse 4.89,		
radio house –, excess hatchways 8.34, light and air[5] 9.98,	70	41
GROSS TONNAGE	404	34
DEDUCTIONS		
Crew space 85.94, master's cabin 9.77, steering gear –,		
anchor gear –, boatswain's stores 4.04, charthouse 4.89,		
donkey engine and boiler –, radio house –,		
storage of sails –, propelling power (actual space[6] 51.27) 126.20		
TOTAL DEDUCTIONS	230	84
NET TONNAGE	173	50

The following-described spaces, and no others, have been omitted, viz.:

Forepeak 20.55, afterpeak 3.84, other spaces (except double bottoms) for water ballast –, open forecastle –, open bridge –, open poop –, open shelter deck 184.71, cabins[7] –, companionways 3.52, galley 4.89, skylights[8] 0.38, wheelhouse 9.73, waterclosets 5.27, anchor gear 4.70, condenser –, donkey engine and boiler –, steering gear 8.09, light and air spaces[9] –, other machinery spaces –, [10]

and, that her name and place to which she belongs is painted on her stern.

LLOYD'S REGISTER OF SHIPPING
Acting for the Republic of Liberia

Surveyor

I agree to the above description and measurement.

Owner, Master, or Agent

pro Chairman

1 Insert "steam screw", or as case may be.
2 Register height of uppermost deck to hull above tonnage deck.
3 Name and give tonnage of each peak tank used other than for water ballast, which is included herein.
4 Carry total of all enclosures to space at end of third line.
5 These spaces are to be added to tonnage by permission of the Principal Surveyor, Lloyd's Register of Shipping.
6 Insert in parentheses the tonnage representing actual machinery space used in ascertaining propelling power deductions.
7 *To be exempted*, cabins and staterooms for passengers must be on a deck which is not a deck to the hull; all other spaces except forepeak, afterpeak, and other water-ballast spaces must be *on* or *above* the upperdeck to the hull. Give tonnage of each space. A cellular double bottom is not included in tonnage.
8 Skylight and air shafts *not over* propelling machinery should be included in this item.
9 Over propelling machinery, including skylights.
10 Insert description and tonnage of any other spaces omitted.

1,500,1,57 (MADE AND PRINTED IN ENGLAND)

Fig. 26

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AT GARRETT HOUSE
MANOR ROYAL, CRAWLEY, SUSSEX, ENGLAND

Lloyd's Register Staff Association

Session 1958 - 59

Paper No. 2

Discussion

on

Messrs. R. Gray's & L. Beckwith's Paper

TONNAGE

LLOYD'S REGISTER OF SHIPPING

71, Fenchurch Street, LONDON E.C.3

Discussion on

Messrs. R. Gray's and

L. Beckwith's Paper

Tonnage

MEETING IN LONDON
18th NOVEMBER, 1958

MR. W. MACMILLAN

Mr. Gray has, tonight, done us a greater service than perhaps he realises in dealing with this paper so expeditiously. There are one or two points which I think should be underlined and, perhaps, one or two blanks which might be filled in.

I think it should be made clear that the Authorities, whose business it is to think about tonnage, are not static in their thinking. There has been considerable interchange of ideas between them and I believe they have gone a good part of the way towards uniformity in the systems of measurement.

The League of Nations, as the Authors have mentioned in their paper, in the years before the war set themselves the task of considering tonnage measurement, and they drew up some rules, now referred to as the Geneva Rules. These Rules were not put into effect until about 1947 when the three Scandinavian countries adopted them, to be joined later by others. I think it should be known and credit be given to the Scandinavian Governments for such a bold step. At present, the following countries subscribe to these Rules, now also known as the International Tonnage Rules or the Oslo Tonnage Rules:— Denmark, Finland, France, Holland, Iceland, Israel, Norway, Sweden, and Western Germany. It is also known that other countries contemplate the adoption of the same Rules. Unfortunately, the United Kingdom and the United States of America have not aligned themselves with the others, and it is between the systems in use in the United States and in Britain that the greatest differences are found. I am sure that the paper, in its manner of presentation, points these differences out very ably.

A point to which attention is drawn is that tonnage measurement is part and parcel of the registry of ships, and the tonnage document has to be given to the Registrar before he can issue the ship's register. Every tonnage case is regarded as an urgent one and any Surveyor carrying out the work is well advised to get the job started early and to let London Office have the underdeck measurement as soon as possible.

I would now like to draw attention to one or two detailed points. In the sketch of the ship on page 32 there is, just forward of the machinery space bulkhead, a tonnage well and it is part of the U.S. Tonnage Rules that in the tonnage well there shall be a 5 in. screw down non-return overboard scupper. In the British Tonnage Rules, it also says there shall be a five inch scupper, but not necessarily led overboard; this particular point has been under discussion with the Ministry of Transport, who have now agreed, in the case of ships where the inboard end of the scupper is very close to the load water line, to this scupper being led to the machinery space or to the hold bilges, a screw down valve being fitted and controlled from the shelter deck. Our experience over the last three years, is that in ships with very small freeboards, and in which there is no sheer on the second deck, these discharges can constitute a danger and we have had several cases where damage to cargo has resulted from leakage from the sea. In one recent case, the ship herself was endangered. The construction of these valves is of some importance and I would like to ask the Authors if it is possible for them to illustrate types of valves which have been satisfactory and those which have not, as we do occasionally get bad designs.

There is another point I would like to make and which concerns the open shelter deck ship. This type is essentially a "tonnage dodger" and, whilst the record of open shelter deckers is quite good, I wonder if the record is not so because of the attention of the men who take such ships to sea. The Tonnage Rules are framed in such a way that exemption of the tween deck spaces below the weather deck requires that battening arrangements shall not be fitted to the tonnage hatch, and it is in this respect that I think the Tonnage Rules are at variance with the Rules appertaining to the safety of ships. The responsible Authorities are fully alive to this anomaly, and it may in time be rectified and perhaps the open shelter decker will disappear, but that is something for the future. I think that the Surveyor attending in a shipyard would not be out of place if he were to call the Builders' attention to the positioning of the tonnage hatch. The picture which Mr. Gray and Mr. Beckwith have included in their paper serves to illustrate this particular point.

I want now to refer to page 7, at the top of the left-hand column of which it will be seen how, under the British Rules, a limit is imposed on the amount of water ballast allowed in the deduction, based on the vessel's gross tonnage. I wonder if the Authors would care to explain this further.

I also want to refer to page 25 in which we see some very neatly drawn little sketches depicting tonnage opening closures. I think it would add to the value of the paper if the Authors could also embody a similar sketch showing the temporary closing appliances fitted in an insulated bulkhead.

Finally, I must say the Authors are to be congratulated on producing what, I hope, will be a paper of real value to the Surveyor on the job, as I believe that was their intention. To my mind they have succeeded very well in their task.

Mr. J. TODD

An officer of the U.S.C.G. commenting on tonnage measurement is reported to have described it as "an esoteric art comprehensible only to its professional practitioners" and many of us here tonight may feel that there is some justification for this point of view.

Since the "Moorsom System" of measurement was more or less adopted throughout the maritime world a little over a century ago, various national governments have been modifying the rules to meet special cases with the result that tonnage law has become generally, through its very complexity, a subject intelligible to nobody but the expert. What we have heard tonight will do much towards resolving many of the difficulties encountered when measuring a vessel and the Authors are to be congratulated for their sensing the need for such a paper, and also for the simple and methodical presentation of the tonnage laws and modes of measurement.

While the majority of Surveyors have at some time in their career the opportunity to carry out admeasurement surveys, I would suggest that only on rare occasions is this done on behalf of the Ministry of Transport. With this in view, it is felt that the frequent references made to British Tonnage measurements, interesting though they may be, could perhaps with advantage have been dropped in favour of further elaboration of the U.S.A. Tonnage Laws.

Athough this, I believe, is only the second paper of its kind read before the Association, this subject has not been neglected by technical institutions outside the Society and it is remarkable that, despite the amount of investigation that tonnage laws have prompted over the years, and the expensive and tedious methods adopted for their fulfilment, the end result gives little or no indication of the earning capacity of the ship.

Blocksidge has shown that American Flag vessels have the highest ratio of nett to gross tonnages in the world, and this is accounted for, to a great extent, by the exemption of the water ballast spaces, while in passenger vessels there is the additional exemption of accommodation in the deck next above the upper deck. It may be of interest to note that this latter exemption was handed down from the early days when the American merchant fleet had few ocean-going vessels. The ruling then was intended as a concession in the matter of tonnage of vessels plying only on rivers and lakes which carried freight in the hull proper with passengers in the erections and for some reason this concession was subsequently extended to ocean-going vessels. While on the subject of enclosed spaces exempt from inclusion in the Gross Tonnage, there is the example of the bridge space on a tanker which by virtue of the closing appliances in the end bulkheads, is declared exempt. Nevertheless, it is common practice to have within this exempted space large fresh water tanks supported on stools and not forming part of the ship's structure. It would be of interest to learn whether these tanks are included in the exemption.

It is understood that it is the rule for all measurements to be carried out to the nearest hundredth of a foot and the custom for measurements in the longitudinal direction to be termed lengths and measurements in the transverse direction termed breadths, irrespective of the shape of the measured space. If the Authors are in agreement with this, perhaps this practice could be read in conjunction with the notes on measurement on page 3.

There is little information in the U.S. Tonnage Regulations governing the standards of crew accommodation which have to be reached to enable these spaces to qualify as deductions. It is presumed, where these requirements are not as precise as they might be, the M.O.T. rules for the Survey of Master and Crew Spaces could be used, and it would be interesting to learn whether this practice is followed, particularly in new construction.

One last point—the Authors in their concluding remarks suggest that wherever possible the tonnage measurements should be taken on the vessel itself. This is the orthodox method of tackling the job, but in these days the measuring rod seems as much out of date as the time wasted in using it; of course, there are bound to be small differences between the scrieve board and the actual ship; on the other hand, the mechanics of measurement on the ship hardly lends itself to accuracy, and saying this, I have in mind the difficulty of measuring these large modern tankers beyond the parallel body.

All things considered, taking measurements from the scrieve board for the underdeck tonnage has much to commend it, and I wouldn't like to see this practice discouraged under any circumstances.

The Authors have given us an excellent paper, instructive as well as interesting, and it will form a worthy companion paper to the now well-thumbed "Safety Equipment."

Mr. W. H. MARSDEN

I had the pleasure of working with the Authors on first joining the Society. In those days, whilst tonnage had been the Society's interest for a number of years, the number of tonnage certificates issued had been trebled over a very short period. This indicates the experience the Authors have had and which has certainly been passed on in this very descriptive paper. It is evident from letters of tonnage enquiries that this paper will be welcomed with interest, and I can do no better than emphasise or enlarge on important items mentioned in the paper.

One of the most controversial items of tonnage is the temporary means of closing to tonnage openings. The paper describes the requirements in full detail with sketches in Appendix I and further detail in Appendix II. Each proposed design requires to be examined. Some arrangements may have to be discussed with the National

Authority who are directly concerned with the approval of these temporary appliances. It will therefore be appreciated why the necessity for forwarding new designs as early as possible and not retaining them until the measurement is forwarded. The Authors mention these plans on page 3, item 3 (f).

The clock has tried to beat the Authors' statement under heading of General Notes on page 2 concerning the International Tonnage Regulations. The Society received a request at the end of last month for measurement under these regulations and will shortly be issuing statements of tonnage. These regulations are similar to the British Rules, having small variations in deductions and exemptions. The only major difference when compared with the British Rules is the overboard scupper, a requirement of the open shelter deck ship and described on page 10, item (j). This is not required for the exemption of shelter 'tweens in the International Rules.

The Authors mentioned on page 3 that for measurement of vessels of unusual construction, guidance can be obtained from London Office. Will the Authors explain this term of "unusual construction" by commenting whether the following examples can be classified as such: —

(1) Bulk carrier with slightly larger height of double bottom, but not excess height, having hopper sides and top side tanks.

(2) The cargo ship with side tanks abreast shaft tunnel having floors of greater height than those under shaft tunnel.

(3) Excess height of double bottom or floors in all vessels, i.e. approximately $1\frac{1}{2}$ Society's rule height.

Turning now to paragraph 7, page 6, the underdeck tonnage also includes the results of tonnages found in measuring recesses in and projection above tank top. These are measured separately and added to or subtracted from the underdeck. A typical example is the addition of the tonnage of the main engine sump recess and the deduction of the tonnage due to the projection of ceiling fitted under hatchways only. For British Rules ceilings under hatchways are ignored.

Referring to paragraph 13 on page 8 in which it describes "enclosed spaces exempted from inclusion in gross tonnage" and gives conditions for such spaces which are: —

(1) Situated on or above upper deck.

(2) Reasonable in extent.

(3) Adapted and used exclusively for the purpose outlined.

The first condition is quite clear and requires no explanation. Will the Authors please confirm, in any actual cases of doubt of applying conditions 2 and 3, the Surveyor can forward detailed plan of the space concerned and the measurements to assist with the decision.

Referring to item *d* of the same paragraph— "Spaces occupied by machinery other than propelling machinery". Would the Authors please comment whether the following are examples of such spaces: —

(1) Engineers' workshop containing lathe, drilling machine, etc.

(2) O.F. filling station containing valves, etc.

(3) Lifts.

(4) Deck machinery control compartment.

(5) Laundry having washing machines, iron machines, etc.

(6) Battery charging room.

(7) Windlass machinery compartment.

(8) Refrigeration machinery compartment.

(9) Dynamo spaces.

Turning to paragraph 19 on page 11 headed "Authorised Navigation Space Deduction", it is of interest to read of the limit placed on steering gear compartments. Generally, these spaces have no limit applied, but I do remember one in particular. It was one of the large tankers, and the steering gear compartment was fitted with engineers' and electrical stores having easy access to the engine room, fire pump equipment, store at aft end, and a large quantity of miscellaneous spare stores for propelling machinery and refrigeration machinery. It can be seen, without doubt, that the steering gear came under the category of being situated within a space unnecessarily large for the purpose. A limit was applied and, on comparison with similar size vessels, the limit was found to be very reasonable.

Item *e* of this same paragraph describes the deduction of dynamo spaces. I am sure the Authors will agree when I mention that dynamo spaces already included in the engine room measurement cannot be given another allowance under this item. If, however, the dynamos were deducted from the engine room measurement as non-propelling power equipment, then they have a separate deduction under this item.

It is of interest to note, with regard to the notation of item (f), concerning pump rooms containing oil fuel and water ballast, that the Authors have mentioned under paragraph 24 (vi) the remainder of the tonnage of the pump space can be credited to the engine room measurement under the U.S. Rules.

On page 16, the Authors have outlined the measurements applied to small craft. At one port the Society have over 40 small craft to measure, so the information supplied will, no doubt, be welcomed. The underdeck of small craft is carried out in the same way as for the large ship. This fact also applies to the rectangular barge, whose underdeck could be calculated $L \times B \times D$, and where use of form T1 appears ridiculous. Small craft are generally of open floor construction which may vary in height throughout the length. It is of interest to note that all ships of open floor construction are measured in one part, even if difference in floor height is greater than 6 in. The Authors have illustrated this point in the bottom sketch of Fig. 5 of the paper.

In certain small open shelter deck vessels measured for British tonnage, the fore peak tank

which is generally exclusively for water ballast, extends above the second deck, which is the tonnage deck. Under the British Rules *bona fide* water ballast spaces above tonnage upper deck are exempt, but these spaces have to be totally independent of water ballast spaces below this deck. Therefore, although part of the fore peak is above the tonnage deck, no exemption can be given and this portion is added to the gross as a break similar to that indicated by the Authors in the third sketch of Fig. 3. The whole of the fore peak would be deductible under navigation spaces, providing it fulfilled the water ballast space conditions.

SPECIMEN RPT. 10.

LLOYD'S REGISTER OF SHIPPING

UNITED WITH THE BRITISH CORPORATION REGISTER

Port

This is to Certify that

the undersigned Surveyor to this Society did at the request of the

attend at on and subsequently for the purpose of certifying compliance with the Merchant Shipping (Crew Accommodation) Regulations 1953 in respect of the single screw motor ship

Builders , Yard No.

The arrangements have been examined and are considered to comply with the aforesaid Regulations with the exception of the following:-

Compliance with the British published Regulations as herein indicated is not to be taken to imply British Ministry of Transport Approval of these arrangements.

....

Surveyor to Lloyd's Register of Shipping

This Certificate is issued upon the terms of the Rules and Regulations of the Society, which provide that:—

"While the Committees of the Society use their best endeavours to ensure that the functions of the Society are properly executed, it is to be understood that neither the Society nor any Member of any of its Committees is under any circumstances whatever to be held responsible for any inaccuracy in any report or certificate issued by the Society or its Surveyors, or in any entry in the Register Book or other publication of the Society, or for any error of judgment, default or negligence of any of its Committees or any Member thereof, or the Surveyors, or other Officers or Agents of the Society."

(Rpt. 10.) 30m,10,52. T. (MADE AND PRINTED IN ENGLAND.)

Finally, to mention a procedure which has developed in recent years due to tonnage measurement, and which involves work other than the actual measurement. This is the verification of crew accommodation at owners' request.

Owners of foreign ships building abroad have requested Ministry of Transport for crew accommodation certificates for use in British ports. The M.O.T. have been unable to issue these certificates for various reasons.

The owners have next approached the Society and requested that crew accommodation be examined for compliance with the published Ministry of Transport regulations. It has been the practice to issue a Survey Certificate on a Report 10 (see this page) on completion of the Surveyors' inspection and trials of crew's accommodation arrangements, in accordance with these Regulations. Emphasis is made of the fact that this certificate is not, of course, to be taken as M.O.T. approval of accommodation.

The published M.O.T. crew accommodation regulations referred to are:—

The Merchant Shipping (Crew Accommodation) Regulations 1953.

Handbook of Crew Accommodation in Merchant Ships.

Circular 1950—Deck Sheathing in Passenger and Cargo Ships.

Notice No. M408—Use of methyl chloride for refrigerating machinery.

Assistance is given by the London Office, on receipt of the following plans:—

(a) Detail arrangements of crew spaces, e.g. cabins, messes, pantries, etc.

(b) Deck covering plan.

(c) Ventilation plans to include both natural and mechanical systems.

(d) Fresh water, drinking water and sanitary water services.

(e) Scuppers and discharges.

(f) Galley plan.

(g) Dry provision store room and refrigeration chambers.

(h) Hospital and medical cabinet arrangements.

In such cases it is usual to inform London Office when such a request from Owners has been received.

This survey should not, of course, be confused with a crew accommodation survey which, at special request, is carried out on behalf of the M.O.T. In such cases the instructions issued by M.O.T. would apply.

In closing, may I express my appreciation of this paper, the subject of which, although recorded in Staff Association in the 1920's, now more than ever requires the full description which the Authors have done so well.

Mr. J. Frize

The Authors remark that Tonnage Regulations have adversely influenced some aspects of ship design in the past. Surely the shelter-decker owes in part its perpetuation, although not its evolution, to the Regulations. This type in the open condition has some pernicious features retained solely for tonnage deduction purposes.

Many of the quoted differences between U.S. and British Regulations are more tangible than in measurement of register depth. In admeasurement for computations, the desired accuracy (which may be quite distinct from that achieved) must cancel some of these differences. Water ballast spaces, however, are assessed much more favourably under U.S. Regulations. The consequent reduction in tonnage must be appreciable—particularly in ore carriers and tankers with tanks other than peak, fitted exclusively for carriage of water ballast.

That permanently void spaces do not merit at least a deduction from the gross tonnage is anomalous. The case quoted in Appendix II shows that at least one tanker owner has tried to circumvent this ruling—albeit unsuccessfully!

Faced with the administration of regulations as complex as these, this comprehensive paper will essentially be consulted. The Authors' recommendation that advice be sought from the London Office will not, nevertheless, pass unheeded.

MEETING IN GLASGOW

2nd DECEMBER, 1958

Mr. A. Hislop

In this paper on "Tonnage" Mr. Beckwith and Mr. Gray have given us a most valuable contribution to the Transactions of the Staff Association which, I am sure, will constantly be referred to by Ship Surveyors called upon to carry out tonnage measurement.

In paragraph 24 (viii) the paper states that electricians' stores are not treated as engineers' stores and consequently are deducted from the engine room measurement. Does this ruling apply to turbo-electric or diesel-electric installations when the electricians' store would appear to warrant allowance as being part of the PP space?

It is to be hoped that, when a Surveyor is dealing with sister ships, a copy of the completed computation for the first ship be returned to him for his guidance in dealing with subsequent similar craft. The repetition of errors in interpretation of the regulations would thus be avoided and the Surveyor would undoubtedly benefit from the further knowledge so provided.

The sample tonnage formula provided at the end of the paper is most clear and concise, and will be of the greatest assistance to all. The method of arriving at the PP allowance is evidently a fairly recent innovation and the old rule of one and three-quarter times the actual machinery space when under 13 per cent of the gross evidently is no longer applied. Perhaps the Authors would care to enlarge on this point.

Mr. D. S. Forsyth

In commencement may I say that we outside Surveyors are indebted to the co-Authors for compiling and preparing this very useful paper on tonnage as a result of their experience gained at Head Office. The official instructions and regulations issued by the various National Authorities are not exactly conducive to ready assimilation, and by their task they have helped greatly in removing this difficulty.

There does not appear to me a great deal that one can raise on a mainly factual paper such as this, but the following points occur to me.

1. The inclusion of an index, I suggest, would greatly enhance the ready reference usefulness of this paper ; this extra labour I would suggest for the consideration of the Authors, and I am sure would be appreciated by outside colleagues.

2. By para. 5 (b), page 3, it is noted with interest that the Surveyor's "yardstick" should include graduated sliding rods of sufficient size, but frankly I have yet to see one in the hands of a colleague, or for that matter in the hands of a M.O.T. Surveyor ; these, I think, are normally handled by his Measurers!

3. Passenger Ships. Para. 16 (iv), page 10. In the more unusual event of a Surveyor having to deal with a ship carrying a number of passengers in the superstructures clear of upper deck, presumably it would be advisable to contact Head Office for guidance, as is it not the case that the American Authorities issue an Appendix to the Tonnage Certificate which includes passenger spaces ; this being for use by an American ship entering U.K. ports?

4. Clause (h), page 12. Gyro Compass Space. Could the Author indicate if allowance could be expected for stabilizer compartments ; also the space for Suez Canal Searchlight if that portion of the forecastle is not already exempt?

5. Page 12. Storage Spaces. Perhaps confirmation will be given that baggage rooms are not deductible. In this respect I have seen a space so intended fitted with cringles and heaters, in order to qualify as an oilskin locker. Also, it might be well to stress that, unlike the British Rules, no allowance is presently made for cold and provision stores.

6. Rounded gunwhale sheer. No mention appears to have been made of this, but in the last of such a type on which I was engaged the rounded gunwale was neglected when the radius was approx. 2 ft. 0 in., as the amount in question was considered to be comparatively small, but with a greater radii the question to be referred to London. In this particular case also, it may be interesting to mention that the top longitudinal frame was of larger scantling than those immediately below, but the uppermost width was allowed to the face of this deeper longitudinal.
7. Would the Authors indicate whether or not in the event of an alteration in an existing ship that the Tonnage Dept. would require information to be supplied similar to that which is given to the Freeboard Department on C11 (contd.)?
8. Page 18. Conclusion. Whilst appreciating the Authors' suggestion that where possible the tonnage measurements should be taken on the ship itself, may I say that I have found that this is very difficult of achievement without unduly affecting a Surveyor's main duties and thus check measurements, in my opinion, are the most that can usually be attained. The example given at the end of the paper is understandably a comparatively simple one in extent to that usually met, and my experience is such that, say two to three T1 forms and five T2 forms, may be required and that entails considerable careful labour.

Mr. W. T. BURNS

The Authors deserve our thanks for presenting this useful paper. Many of us who have not been concerned with tonnage matters since drawing office days will find it a very conveniently arranged guide to the subject. There are a few points, however, upon which I would like to comment: —

In paragraph 10, in connection with the measurement of 'tween decks, it might be inferred that in those cases where the underdeck tonnage is calculated in sections due to breaks in the double bottom the 'tween deck should also be divided into similar sections even though there might not be breaks in the 'tween deck. As there does not seem to be any valid reason for such a procedure I shall be glad if the Authors will confirm that 'tween decks may be treated as one unit irrespective of the treatment of the underdeck portion.

In their conclusion the Authors state a preference for measurement from the ship instead of from the lines plan or scrieve board, and they also draw attention to the desirability of agreement between the computation of the Society and that of any National Authority which may also be concerned. The most practical way of attaining both of these desirable ends would seem to be by an agreement between the Society's Surveyor and the Surveyor to the National Authority to arrange a joint effort of measurement. A drawback here would be the differences in the divisions of spaces required by Tables I and IA, and also, perhaps, the different requirements regarding the establishment of breaks. Would the Authors state what the position would be if a measurement in accordance with British Rules was carried out in conjunction with a Ministry of Transport Surveyor? Would such a measurement be considered only as a check on the lines plan, and would the Tonnage Measurement Form have to be filled in by the Surveyor in accordance with the U.S. Regulations? Alternatively, would the British measurement be accepted by Head Office under some special dispensation? Should the former be the case the Surveyor could save time by being present only at a limited number of measuring visits sufficient as a check on the lines plan.

Mr. J. C. BROWN

I would like to express my appreciation to the Authors for the production of this very useful paper on Tonnage Measurement, as I have found it difficult, at times, to elucidate the instructions laid down in the U.S. Customs Regulations, Part 2, "Measurement of Vessels", and in this connection I wish the Authors had produced their paper at an earlier date.

Perhaps the Authors would comment on the apparent contradiction in the paper, where on page 12 it states that "dynamo spaces when situated below the upper deck are deducted", while on page 31 the list given of spaces deducted from the gross engine room tonnage includes "generators (if not used in connection with main engine and its auxiliaries").

I would like to make a few remarks regarding tonnage measurement in the case of the "convertible" open and closed shelter ship where it is necessary to carry out separate measurements for both conditions, and I would be glad to know if the Authors consider that any short-cut methods could be adopted.

I am interested to note the omission from the paper of any reference to crew space standards in connection with tonnage measurement, in view of the declaration which the Surveyor is required to sign when completing Form T2 but feel that this omission may be intentional.

Mr. W. R. D. SAXTON

The Authors are to be congratulated on the preparation of a most useful paper which will prove to be of great value to those of us who find that our duties include the admeasurement of a ship for the issue of a tonnage certificate by the Society. As has been mentioned in the paper, the United States Tonnage Regulations which have been adopted by the countries concerned are not

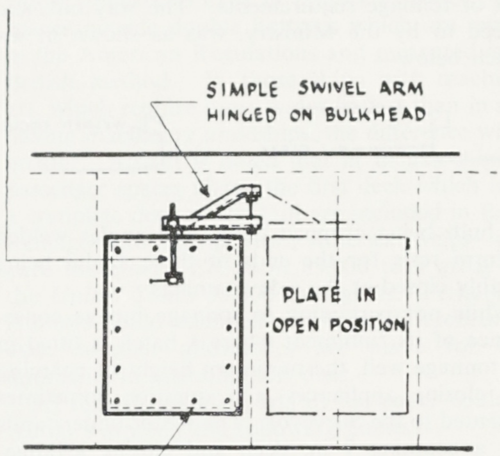
readily available, and to date the average Surveyor faced by his first tonnage admeasurement has had little information to which he might turn for guidance. After his computation is forwarded for consideration he is also unable to learn from the mistakes he undoubtedly made as it is not the general practice to return copies of the completed computation to the Surveyor. This lack of knowledge as to the measure of success achieved I personally have found discouraging in the past, and although the Authors mention that in certain cases photostat copies have been returned to the Surveyor concerned they also add that in such instances the information given is to be treated as confidential.

In this connection I should like to mention a case in which I was concerned, where, on presenting the tonnage certificates to the owner's representative for signature I was asked how he could be expected to agree to the tonnages assigned if he had been denied the opportunity of seeing the computation. He was a gentleman to whom tonnage was not a mystic science and he refused to sign. I, therefore, wrote to London for a copy of the computation. It was not forthcoming, and a difficult situation was finally overcome after a not inconsiderable amount of talking attended by the discomfiture of listening to a number of harsh words about the Society's lack of faith in its tonnage figures. This unfortunate reaction was difficult to refute in the face of a statement, subsequently confirmed, that in the case of British flag vessels the Ministry of Transport would readily make the tonnage computation available to owners if requested, and in the circumstances some explanation by the Authors in their reply as to the reasons why the Society adopts its present attitude would be appreciated.

I refer now to the specimen T2 report included in the paper in which it is noted that the columns relating to crew space, lighting, ventilation, etc., have been left blank. It is assumed that this omission is intentional as being considered outside the scope of the paper on tonnage, but in view of the question of crew space standards being closely connected with the issue of tonnage certificates would the Authors be kind enough to clarify the following point. The standards of crew space requirements applied by the Society are those laid down in the British Ministry of Transport Regulations. In the event of an owner, or builder, of a Liberian, Panamanian or Nicaraguan vessel not wishing to comply with these regulations does the Society refuse to issue a tonnage certificate on behalf of these countries?

In conclusion I refer to Fig. 13 in the paper showing an approved arrangement designed to facilitate the manipulation of steel plates closing tonnage openings in superstructure bulkheads. Is the note regarding the sliding rail being box ended of particular significance, and if a gallows crane was fitted as indicated below would the arrangement be acceptable?

TONNAGE PLATE SUSPENDED, & ADJUSTED IN THE VERTICAL PLANE, BY MEANS OF A DRAW BOLT (PROVIDED WITH A LOOSE TOGGLE BAR AT THE BOTTOM END) FITTING THROUGH A LUG WELDED TO THE TONNAGE PLATE, AND INTO A NUT WELDED TO THE SWIVEL ARM.



HOOK BOLTS NOT LESS THAN 12" APART

Mr. R. G. LOCKHART

In congratulating the Authors for their neat presentation of this paper I would say that the historical reference is most interesting.

Any comments made or questions asked are merely in a quest for further knowledge.

Perhaps the Authors could clear up a point regarding the register length with reference to both paragraph (b) and Fig. 1 on this subject. In vessels having no sternpost the American Regulations seem to leave no doubt. In the case of British Rules it would appear that with a trunk the length should be measured to the fore side of this trunk or its line extended to the deck. Fig. 1 appears to be such a case but the only indications of the length is to the foreside of the stock. Perhaps the Authors could further confirm that in the case of British Measurement in this type of ship and not having a rudder trunk that the length is then measured to fore side of the stock.

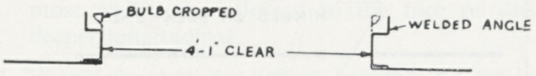
Regarding the allowance for ceiling perhaps the Authors could state that only 3 in. is allowed even in the case of an ore carrier where double ceiling may be fitted throughout the entire ore hold.

In reference to paragraph 8, special exempted water ballast spaces, can it be assumed that a double bottom tank is where depth does not exceed twice the rule double bottom and anything deeper than this is taken as a deep tank?

In the note on round end erections both for forward and after end the term "decided flat" is used. Could the Authors define this a little more precisely. Is it when the flat exceeds one-half of the preceding breadth?

The section on open shelter deck spaces together with Fig. 13 is a most enlightening reminder of

tonnage requirements for this type of vessel. Regarding the breadth of the tonnage hatch the writer came across a case where a ship was committed to 4 ft. 1 in. clear opening between the heels of the bulb angles forming the athwartship coamings and if the rest bars had been fitted inside this the clear openings would have been a violation of tonnage requirements. The way out, and agreed to by the Ministry, was as shown in the sketch below—



the bulb being cropped down and angles welded to form rests for the ends of these angles being suitably closed at the side coamings.

While not pertaining to tonnage but as consequence of its fulfilment where a hatch is fitted in the tonnage well, the minimum height of coaming and closing appliances is a question sometimes presented to the Surveyor. The writer understands that a coaming 9 in. deep and closing arrangements as required for an exposed hatchway on the freeboard deck would be satisfactory. Confirmation of this would be appreciated.

In these days of conversion from open to closed shelter deck ship, the method of easy conversion is always important. Perhaps the Authors could make reference to this in their reply and, if possible, provide a sketch showing a simple method of converting the tonnage hatch, and the tonnage openings in the 'tween deck bulkheads to closed shelter deck requirements.

The value of this paper will only be fully appreciated when the Surveyor has to carry out a tonnage measurement and perhaps the Authors will be secretly blessed for their endeavours.

Mr. F. H. ATKINSON

The Authors are to be thanked for their commendable and informative paper. There is, however, one point which I would like clarifying and one proposition I would like to make.

In Appendix II, Paragraph 3, they state that the small after hatch shown in Fig. 16 could not be accepted as a cargo hatch as it did not lead to a hold. If, however, there had been a similarly small hatch in the 'tween decks leading to a hold below, to what limits could the shelter deck and tonnage hatch have been reduced, or when does a cargo hatch become so small that it is considered an access hatch?

Would the Authors also comment on a proposal to make redundant the open shelter deck type of ship. To replace this I would suggest that the tonnage of a ship be a factor of

$$\frac{\text{Assigned or Scantling draught}}{\text{Maximum Geometric draught}}$$, all tonnages before correction being evaluated as for a closed shelter deck ship. By this method an Owner could design his ship for any tonnage up to that obtained with the vessel as a closed shelter deck ship floating at its maximum geometric draught, without hazarding his cargo by fitting, to quote the freeboard rules, "a permanent middle line opening". Indeed, I would propose the simplifying of tonnage even further by making the tonnage of a vessel its maximum deadweight.

WRITTEN CONTRIBUTIONS

Mr. J. R. CHESHIRE (Kobe)

I would like to begin by congratulating the Authors in compiling this paper on tonnage and to the manner in which they have dovetailed the American and British regulations without becoming too involved. I am sorry to say my main difficulty on reading this paper was to find material for discussion as a very high percentage of the paper is directly quoted from the regulations, and here I think that the Authors could have departed in a few places from the pure wording of the regulations.

In this respect if I may mention one phrase and that is "upper deck". "Upper deck" is defined in the paper and is then used throughout. In the body of the paper I think the Authors could have used "tonnage deck" or upper deck as the case may be, and thus avoided some confusion with those that are less familiar with the tonnage regulations.

By making the above remarks I do not detract in any way from the value of this excellent paper and I am sure in the future it will be a guide and reference book to those of us who are faced with tonnage measurement.

I would, however, like to put forward for discussion the following points.

In defining the tonnage deck on page 4 it is considered the statement that the tonnage deck is the second deck from the keel in vessels having more than two decks is not quite complete. It is admitted that paragraph 2 (c) gives added information, but in my opinion the second half of paragraph 1 (a) should read "The tonnage deck in vessels of more than two complete decks is the second continuous deck from the keel, interruptions in way of engine and boiler openings, cofferdams, peak tanks, hatchways, not being considered as breaking the continuity of a deck".

On page 5 "Breaks in double bottom", it is considered an indication should have been given as to where the vertical plane should be established in the case of a sloping break, i.e. to the top terminal point of the slope and not the bottom terminal point of the sloping tank top.

Paragraph 15, on page 10, "Excess of hatches", it is considered these could be defined as being hatches on an open deck that are directly over, and giving access to, a space already included in the gross tonnage.

In my opinion paragraph 16 (ii) should read "the tonnage of each between deck space above the tonnage deck and below the upper deck to the hull". In the same paragraph, the statement

regarding treatment of passenger cabin, etc., for British Rules could be misleading and should read "Cabins, staterooms for passengers or owners no matter where located are included in the gross tonnage".

On page 15, paragraph 26 in describing light and air spaces no reference has been made to any encumbrances in the light and air casings which would invalidate that portion of the casing for the 'tween deck height above, also that the funnel, i.e. exhaust casing and silencer casing in a motor ship can be included as light and air provided it is closed in at the top otherwise it is an open space and not available for measurement.

On page 28, "Shelter deck ship", would it not be sufficient to report an underdeck only, for the closed condition, if the actual measurement as sailing was for the open condition?

Under the same heading it is not understood why the scuppers in the tonnage well must be permanently closed as these scuppers are of the screw down automatic non-return valve type, controlled from above the shelter deck and having open and shut indicators, this being the maximum that would be asked for in any scupper discharging overboard from below the freeboard deck.

I would like to add one further contribution and that is in the case of open shelter deck ships which have the combination of, say, engine casing and store spaces in the 'tween decks extending almost to the ship's side. In cases like this in order to gain access from one exempt 'tween deck space to another exempt 'tween deck space, access is gained by means of a passageway. I think it is important to mention that the minimum clear width of this passageway should be 3 ft.

In conclusion would the Authors consider as acceptable the Rule II method set out in the British tonnage regulations in the case of an existing ship where the desired information could not be obtained and the time was not available for a complete re-measurement.

Mr. O. CLEMMETSEN (Hamburg)

The tonnage regulations, since they have a historical origin which does not necessarily bear any relationship to conditions today, and which have been modified by precedent, present many difficult problems unless one is constantly using them. Such a paper as this is therefore of real value, answering as it does many questions which frequently arise, particularly as the majority of Surveyors have never measured a ship for tonnage, e.g. in Germany any ships required to be measured by the Society are measured on our behalf by the Deutsche Schiffsvermessungs Amt.

It is the practice for each maritime country to accept the tonnage certificates of others, but this appears to discriminate against British ships in some cases. For instance some European countries allow the breadths to be measured to the inside of deep tonnage frames fitted at alternate frames in order to give high deadweight to tonnage ratio, and also to circumvent manning regulations which require an increase in crew if the gross tonnage exceeds 500. I have been informed that if such ships were measured under British Regulations a much higher tonnage would result. These ships appear therefore to be paying less dues and are more economically run than their British counterparts. A similar state of affairs appears to exist in respect of water ballast spaces outside double bottoms which are omitted in the American Regulations and measured in the British method. In those ships with machinery aft, which require more water ballast than in ships having machinery amidships, the difference will be greater. Also it is noted that in British ships the passenger spaces above the first deck which is not a complete deck to the hull are included in British tonnages and exempt from American ships—compare the *Queen Elizabeth* 83,000 tons gross with the *United States* 53,000 tons gross. Perhaps the Authors could comment on these differences and state whether allowances are made for these anomalies in assessing port dues.

As regards specific parts of the paper could the Authors amplify the following points:—

General Notes

What are the principal differences between measuring a ship for Suez and Panama Canal Tonnages and those outlined in the paper, and what additional information is usually required?

Having read the M.O.T. instructions for the use of Moorsom's measuring apparatus (has the Society such a device?) it seems difficult to apply it to holds where depths exceed 20 ft. and I should be interested to know what procedure is adopted in these cases and also whether a Surveyor has so far had to measure a ship completely in this manner and how long did it take. Done in this manner the work would appear to require three men.

Definition

It seems difficult to relate masts, etc., to tonnage but may be there is some additional explanation here.

Ceiling, etc.

The omission of any allowance for grounds must surely make a considerable difference between the actual and measured capacities of refrigerated spaces, especially as regards the beams. Since the insulation is in place when the ship is measured, presumably reliance would have to be placed on plans for ascertaining whether an addition to the measured dimensions is necessary on account of grounds.

As cargo battens are frequently removed after the ship has been in service, should a Surveyor draw the attention of the owners to the effect on the tonnage in such cases?

Register Length

Where is the after terminal in the case of a Simplex type of sternframe?

Superstructure

It is assumed the term "ceiling" in the case of cabins, refers to the inner lining on the walls.

PARAGRAPH 12 (i)

It might be mentioned that athough the M.O.T. instructions require two tonnage openings in 'tween deck bulkheads of shelter deckers, one opening of twice the size can be fitted in British ships. Also that additional openings for access can not be cut in shelter 'tween deck bulkheads, either in the bulkhead itself or in the closing plate. However, if the access is to an enclosed space (such as a refrigerating machinery space) within the 'tween deck space (whether enclosed by wood or steel bulkheads) then the additional opening is permitted.

PARAGRAPH 12 (iii)

Coaming height. Where the second (upper) deck is stepped immediately forward of the tonnage well, where is the height of the coaming measured from the deck inside or outside tonnage well—in both British and American ships?

PARAGRAPH 13 (c)

What type of ship has no part of the propelling machinery below the upper deck?

PARAGRAPH 14 (a)

What is the British attitude towards radius corners in the deck plating at tonnage hatches?

PARAGRAPH 14 (j)

It might be mentioned that Oslo Convention countries waive the fitting of a S.D.-N.R. valve. The fitting of this valve in O.S.D. ships having 2 in. minimum freeboard is detrimental to the safety of the ship and I should be interested to know if the M.O.T. have ever approved the draining of the tonnage well to the machinery space in ships with machinery aft.

PARAGRAPH 14 (k)

It might be mentioned that the Netherlands authorities now require two tarpaulins in shelter 'tween decks.

PARAGRAPH 25 (c)

In the case of diesel engine seatings in which the double bottoms are frequently raised transversely in way of the engine, is this to be taken into account in the same way as a longitudinal break in the double bottom?

Existing Vessels

Are the dimensions of auxiliaries simply those of an imaginary enclosing rectangular box?

In conclusion, could the Authors state broadly what are the principal differences between the British and American regulations and the International Regulations adopted by the Oslo Convention countries, and also state whether there are any particular differences between measuring a tanker and a cargo ship.

MR. J. WORMALD (Cardiff)

The deeper one delves into the intricate and underground workings of the Tonnage Regulations and tries to reconcile them with freeboard and classification regulations the more confused one would become if it were not for the efforts of benevolent guides such as the co-Authors of this paper and others who have presented papers on similar lines to the Staff Association.

The co-Authors of the paper on "Tonnage" have made extensive use of italics to illustrate the variations in interpretation as between British and United States Regulations; if they had tried to indicate by similar methods only the major differences as between other authorities we would assuredly have been faced with what, for want of a better description, would be a printer's nightmare!

The co-Authors are pleased to admit that the interpretations they have put on many of the rules are the interpretations put on them in our Head Office and are not necessarily those of the promulgating authorities. Outport Surveyors frequently come into conflict with irate, but nonetheless co-operative, superintendents who are conversant with the British Regulations, but who cannot understand why those of other countries when applied by the Society are different—the Authors have supplied us with a convincing answer, but will we, in our turn, be able to convince the superintendents—it must be admitted that these remarks apply more frequently to questions connected with Safety Certificates, but they must apply to tonnage problems to a lesser extent.

And now for a simple question. Tonnages are normally worked out to two places of decimals, but in most publications and on many official certificates the figures after the decimal point are omitted; should we ignore the fractions completely or should we work to the nearest whole number when we are asked by Head Office to supply or insert the appropriate figure on a certificate? As an example, if the net tonnage of a ship is 5825·51, should we say 5826 or 5825?

The Authors have done much to clarify matters connected with open and shelter deck ships; the paper, "Some Recent Developments in Swedish Shipbuilding", referred briefly to this subject and gave some interesting information on the Swedish Regulations governing exemption of the shelter deck spaces from tonnage measurement which are seen to differ in important respects from these given in the present paper on American and British practice.

In the earlier paper we were told of an arrangement of shelter deck tonnage opening with steel covers and securing bolts which has been patented and which can be used whether the ship is "open" or "closed", but we were not told the height of the coaming although the sketch indicated that it was probably 12 in. To qualify for tonnage exemption in the O.S.D. condition the mean height of the

coaming must not exceed 12 in. above the deck, but, in order to obtain the maximum permissible draught, the minimum height of the coamings of exposed hatchways on the freeboard deck when the ship is in the C.S.D. condition should be 24 in. It would appear that the patented arrangement satisfies the tonnage regulations, but would the Authors of the present paper be prepared to comment or say whether it conforms with classification and freeboard requirements unless "intermediate draught" clauses are brought into operation?

The paper, considered as a whole, gives one the impression that too many naval architects have spent, and are still spending, too much time on judicious juggling, the purpose of which is to seek out and to take full advantage of the anomalies which abound in tonnage and freeboard regulations when dealt with concurrently. Would they not be far better employed in co-ordinating, or working out a logical compromise between, the various aspects of ship design so as to give some measure of consistency in methods of measurement and nomenclature? Why should there be a dozen or more ways of measuring the length of a ship and why should the lower of two decks be officially described as the "upper" deck simply because the deck above it has a small opening which officially has no permanent means of closing the opening?

It is not suggested that the juggling to which reference has been made is anything but ingenious and fair, but engineers, who are often accused of being much too precise, may be excused if they think that a system which allows a shipowner to change the registered tonnage(s) of this ship simply by blacking out one set of freeboard marks and painting in another set, is carrying ingenuity, or simplification, too far.

Tonnage measurement is used as a basis of assessment for so many purposes that it seems only right that the regulations should not allow themselves to be circumvented by ingenious devices. How can the uninitiated consider satisfactorily a system which is so flexible that a ship can legitimately carry 300 tons or more of cargo whilst being rated as a "75 tonner" or when a ship whose gross tonnage was 1,619 tons was found, on remeasurement when it came to applying certain sections of the Safety of Life at Sea Convention, to be only 1,598 tons?

The later comments may be considered "out of order", as well as Utopian, but the co-Authors are to be congratulated on the clarity of their explanation of an interesting and complicated subject and every outport Surveyor should be more than thankful to them for sparing the time and effort necessary to provide help and guidance in such a useful and easily assimilable form.

AUTHORS' REPLY

One of the objects in giving this paper on "Tonnage" to our Staff Association was the hope that a lively and interesting discussion, both verbal and written, would ensue. It was also intended to give our colleagues, actually carrying out tonnage measurements, the opportunity to make known the difficulties which they have encountered in practice. The Authors would therefore like to thank all colleagues who attended the reading of the paper both in London and Glasgow, and those who have contributed to the discussion.

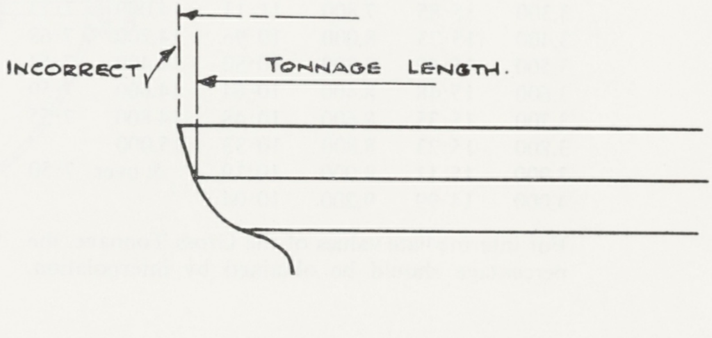
Before replying to the discussion, the Authors wish to draw attention to the following errors in the paper:—

(i) The Secretary of the 1849 Commission was George Moorsom and not Moorson as printed.

(ii) Under the definition of Register Length (a) on page 4 read plating for planking of steel or iron ships, and under the same heading but for British Rules (b) read "to fore side of rudder stock" for rudder trunk.

(iii) Under Section 14, page 9, radius of curvature of middle line opening corners should be not greater than 9 in. not 5 in. as printed.

(iv) In Appendix I, Fig. 1, the tonnage length is shown drawn to the after end of the upper deck whereas it should be to the aft end of the second deck.



MEETING IN LONDON

18th NOVEMBER, 1958

To Mr. W. Macmillan

Mr. Macmillan raises and enlarges on a number of points worthy of the attention of all Surveyors, especially with regard to the shelter deck ship.

It is interesting to note his remarks regarding the 5 in. scupper fitted in the tonnage well. The ideal case would be to have this scupper removed altogether, but until such time occurs the Authors are in agreement with Mr. Macmillan, and feel that some indication should be given showing types of valves which have proved satisfactory in service. Hence the sketches shown opposite are included for information.

With regard to the limit imposed by the British Rules on the amount of water ballast allowed as a deduction, it is felt that this could be best explained by giving a table showing the maximum allowance for water ballast as a percentage of the gross tonnage and by illustrating how this limit is imposed.

Maximum Allowance for Water Ballast as Percentage of the Gross Tonnage

Gross Tonnage	*Per Cent*	*Gross Tonnage*	*Per Cent*	*Gross Tonnage*	*Per Cent*
1,000 & under	19·00	4,100	14·87	9,400	9·91
1,100	18·85	4,200	14·75	9,600	9·77
1,200	18·71	4,300	14·64	9,800	9·64
1,300	18·56	4,400	14·52	10,000	9·51
1,400	18·42	4,500	14·41	10,200	9·38
1,500	18·27	4,600	14·29	10,400	9·26
1,600	18·12	4,700	14·18	10,600	9·14
1,700	17·99	4,800	14·06	10,800	9·03
1,800	17·85	4,900	13·95	11,000	8·92
1,900	17·71	5,000	13·84	11,200	8·82
2,000	17·57	5,200	13·62	11,400	8·71
2,100	17·43	5,400	13·41	11,600	8·61
2,200	17·29	5,600	13·20	11,800	8·52
2,300	17·16	5,800	12·99	12,000	8·43
2,400	17·02	6,000	12·79	12,200	8·34
2,500	16·89	6,200	12·59	12,400	8·26
2,600	16·76	6,400	12·39	12,600	8·18
2,700	16·62	6,600	12·20	12,800	8·10
2,800	16·49	6,800	12·01	13,000	8·03
2,900	16·36	7,000	11·83	13,200	7·96
3,000	16·23	7,200	11·65	13,400	7·90
3,100	16·11	7,400	11·47	13,600	7·84
3,200	15·98	7,600	11·30	13,800	7·78
3,300	15·85	7,800	11·13	14,000	7·73
3,400	15·73	8,000	10·96	14,200	7·68
3,500	15·60	8,200	10·80	14,400	7·64
3,600	15·48	8,400	10·64	14,600	7·59
3,700	15·35	8,600	10·48	14,800	7·55
3,800	15·23	8,800	10·33	15,000	
3,900	15·11	9,000	10·19	& over	7·50
4,000	14·99	9,200	10·04		

For intermediate values of the Gross Tonnage, the percentage should be obtained by interpolation.

Example:

Assume gross tonnage	=	10,310·88 tons
Total double bottom space	=	792·33 tons
Total deductible water ballast spaces	=	458·49 tons

From Table maximum allowable water ballast = . 9·31 % of 10,310·88
= 959·94 tons

Note: The maximum allowance obtained from the table includes the total exemptible double bottom space.

Total water ballast spaces in ship.

Extemptible double bottom	=	792·33 tons
Deductible water ballast	=	458·49 tons
		1,250·82 tons

This figure exceeds the maximum allowable, i.e. 959·94 tons therefore the amount of water ballast space which can be allowed as a deduction from the gross tonnage = 959·94—792·33: 167·61 tons.

As suggested by Mr. Macmillan, it is agreed that a sketch showing the temporary closing appliance fitted in an insulated bulkhead would add to the value of the paper and this is given on page 14.

To Mr. J. Todd

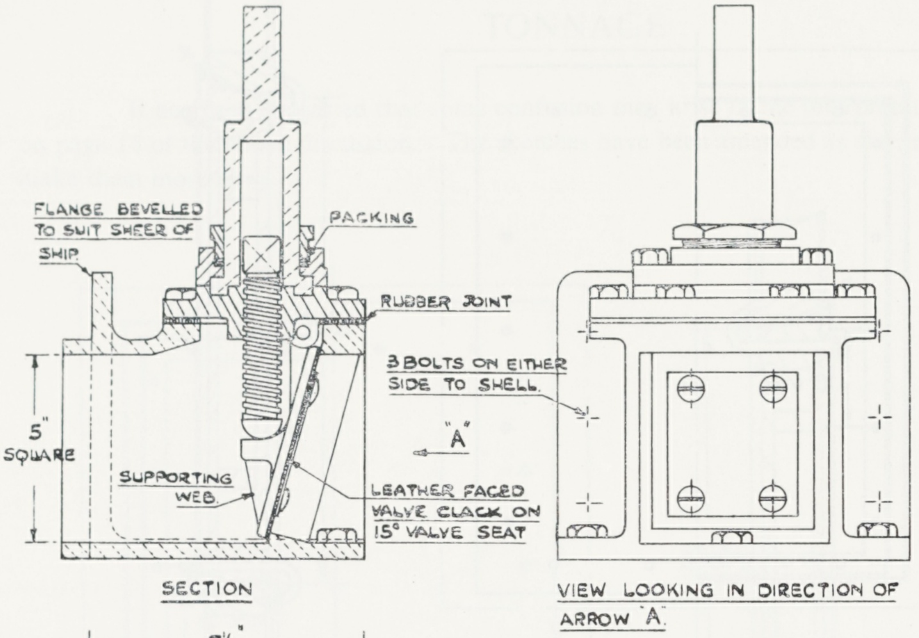
We agree with Mr. Todd that only on rare occasions has a Surveyor to the Society carried out a tonnage measurement on behalf of the Ministry of Transport. We would, however, refer him to paragraphs 2 and 7 of the General Notes in the paper where it is stated that the Society has, in a number of cases, issued statements of tonnage admeasurement in accordance with the British Tonnage Rules. To have omitted the references in the paper concerning the British Rules would, we feel, have been doing an injustice to those of our colleagues who have to employ these rules in practice.

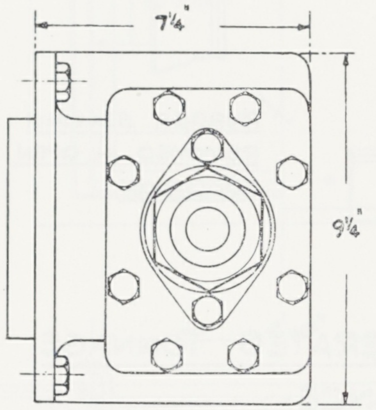
Referring to the query regarding large fresh water tanks inside an exempted bridge space, we would confirm that provided the tank is not integral with the bridge structure, then it should be exempted with the bridge space.

The rules do not state the degree of accuracy to which measurements must be made, but as measuring tapes are to be graduated in feet and tenths of a foot, it is reasonable to expect accuracy to the nearest twentieth of a foot. The Authors would agree that it is usual for lengths to be measured in a longitudinal direction and breadths in a transverse direction.

With regard to Mr. Todd's reference to standards of accommodation in crew spaces, we would refer him to the reply given to Mr. J. C. Brown.

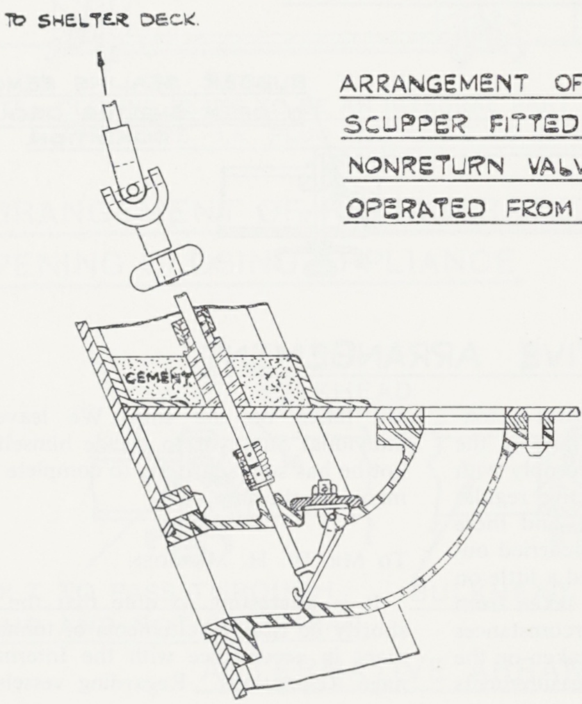
We are in sympathy and agreement with Mr. Todd's comments with regard to taking underdeck measurements from the scrieve board in preference to taking them from the ship.



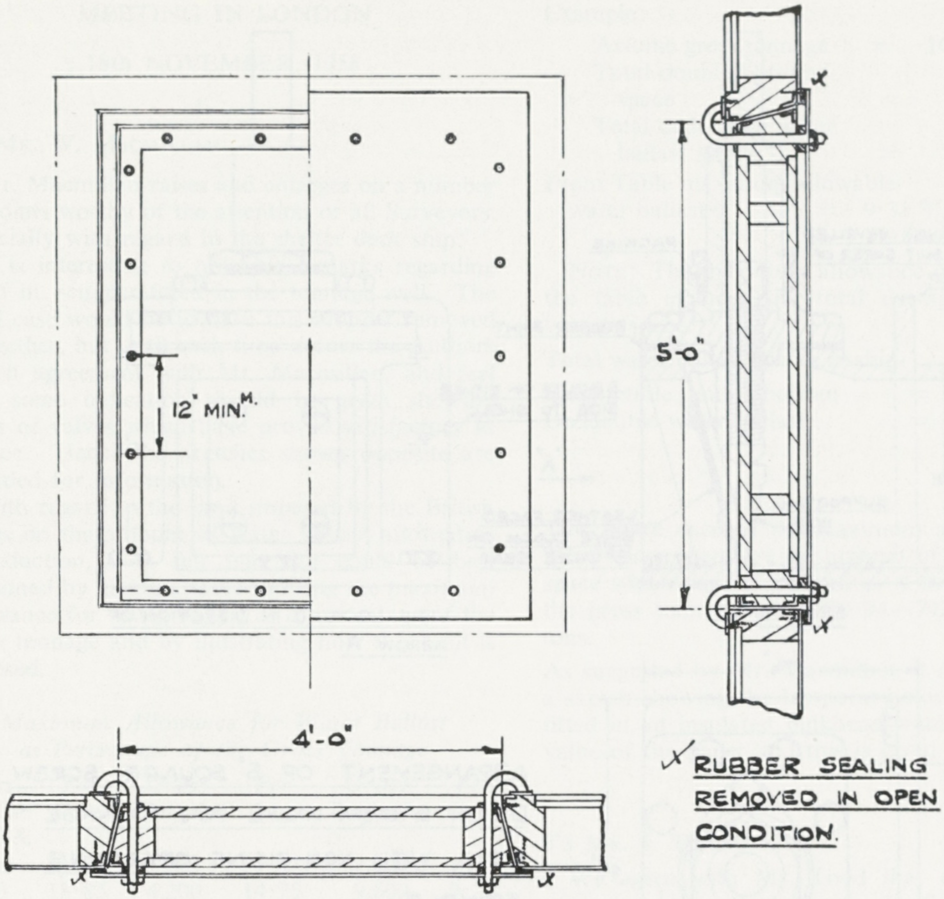


ARRANGEMENT OF 5" SQUARE SCREW DOWN STORM VALVE FOR TONNAGE WELL WITH NON-RISING OPERATING SPINDLE.

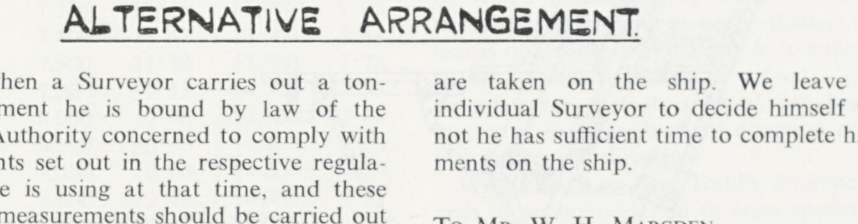
MATERIAL:- ALL BRASS (EXCEPT LEATHER FACE OF VALVE CLACK AND RUBBER COVER JOINT.)



ARRANGEMENT OF 5" INSIDE DIAMETER SCUPPER FITTED WITH SCREW DOWN NONRETURN VALVE GEARED TO AND OPERATED FROM SHELTER DECK.



ARRANGEMENT OF REFRIGERATED TONNAGE OPENING CLOSING APPLIANCE.



ALTERNATIVE ARRANGEMENT.

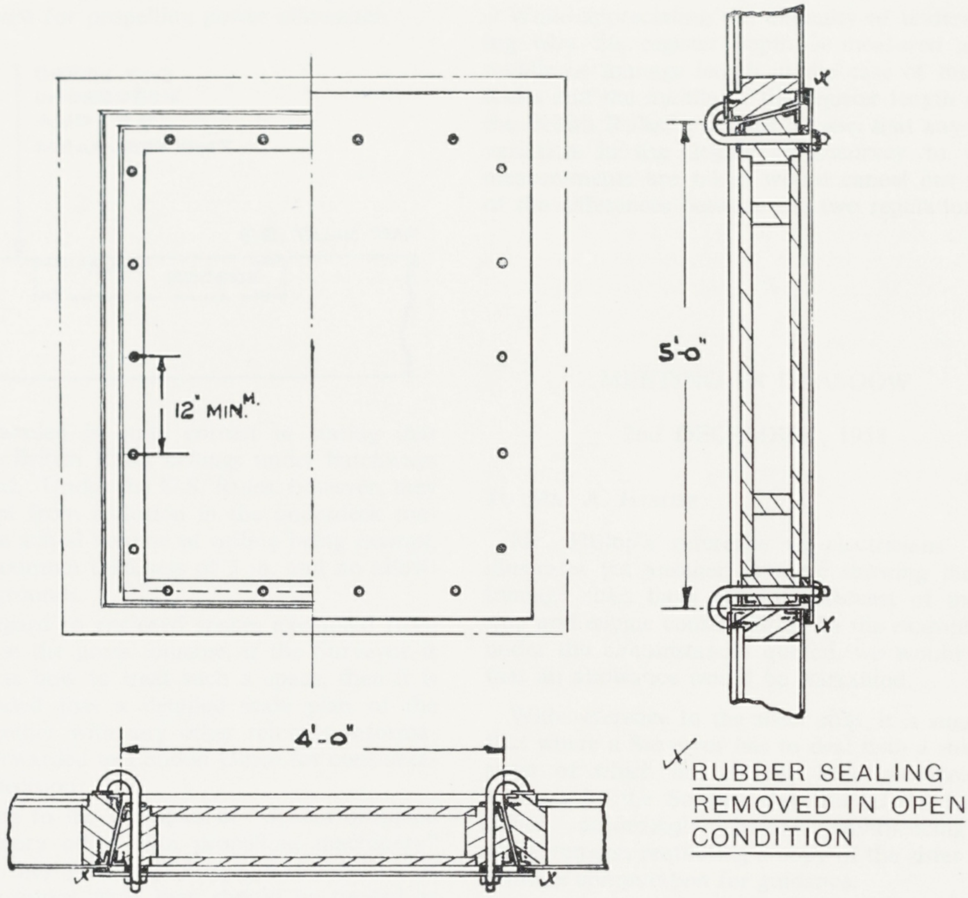
However, when a Surveyor carries out a tonnage measurement he is bound by law of the Government Authority concerned to comply with the requirements set out in the respective regulations which he is using at that time, and these state that the measurements should be carried out on the ship. Governments have relaxed a little on this ruling by accepting measurements taken from a scrieve board, provided time or circumstances do not permit the measurement being taken on the ship, and provided that some check measurements are taken on the ship. We leave it to the individual Surveyor to decide himself whether or not he has sufficient time to complete his measurements on the ship.

To Mr. W. H. Marsden

It is interesting to note that the Society will shortly be issuing statements of tonnage measurement in accordance with the International Tonnage Regulations. Regarding vessels of unusual

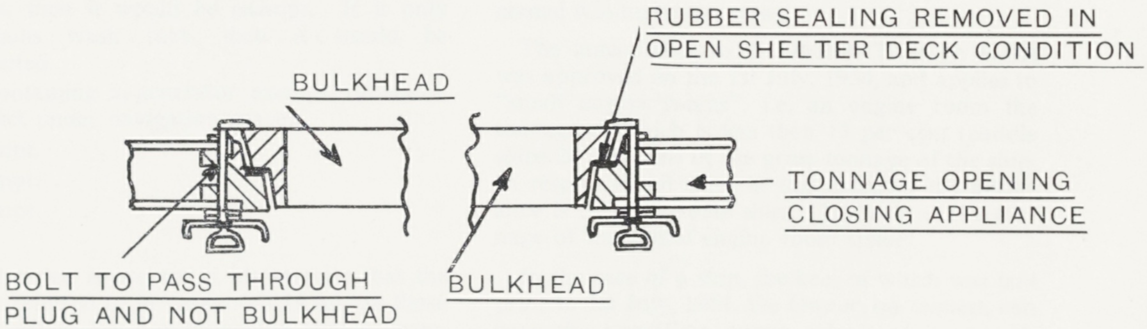
TONNAGE

It has been suggested that some confusion may arise in the interpretation of the sketches on page 14 of the above discussion. The sketches have been amended as shown below in order to make them more clear.



NOTE:—CLOSING PLATE TO BE AN INTEGRAL PART OF THE CLOSING APPLIANCE. i.e., PLUG AND PLATE TO BE BUILT AS A SINGLE UNIT

ARRANGEMENT OF REFRIGERATED TONNAGE OPENING CLOSING APPLIANCE

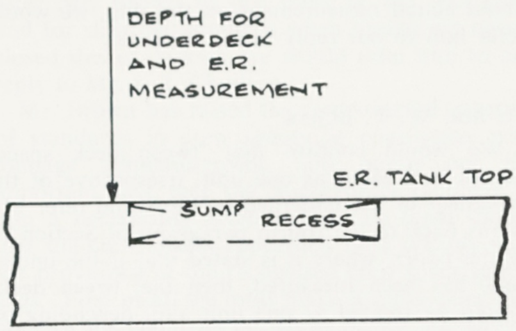


ALTERNATIVE ARRANGEMENT

construction, we consider that the examples given by Mr. Marsden and enumerated (1), (2) and (3) would fall into this category.

Mr. Marsden also brings out a point with regard to the measurements of recesses in or projections above the tank top.

It should be noted that a main engine sump recess need only be included in the underdeck measurement if it is included in the engine room measurement for propelling power allowance.



Mr. Marsden is quite correct in stating that under the British Rules ceilings under hatchways are ignored. Under the U.S. Rules, however, they are exempt from inclusion in the underdeck tonnage. The actual volume of ceiling being exempt, with a maximum thickness of 3 in. and no allowance for grounds.

With regard to enclosed spaces exempted from inclusion in the gross tonnage, if the Surveyor is in doubt as how to treat such a space, then it is recommended that a detailed scale plan of the space, together with any other relevant information be forwarded to London Office for consideration and decision.

Referring to the examples of "Spaces occupied by machinery other than propelling machinery" quoted, if they are closed in spaces situated on or above the upper deck, they should be treated as follows: —

(1) Exempt.

(2) Exempt.

(3) The space occupied by the machinery operating the lift would be exempt.

(4) Exempt.

(5) If the laundry contains a washing machine or press, then it would be exempt. If it only contains wash tubs, then it would be deducted.

(6) If containing a generator exempt, otherwise deduct under navigation spaces.

(7) Exempt.

(8) Exempt.

(9) Exempt.

Mr. Marsden is correct in his surmise that the dynamos referred to in paragraph 19 (c) are those dynamos which are non-propelling engine accessories.

To Mr. J. Frize

While it is true that the shelter decker would not exist but for the tonnage regulations, it must be borne in mind that it has attained a great popularity with many shipowners which is the main reason for its continued existence. Mr. Macmillan has, we feel, made an adequate reply to this point in his comments.

While appreciating the difficulty of understanding why the register depth is measured at the middle of tonnage length in the case of the U.S. Rules and the middle of the register length under the British Rules, it cannot be seen that any small variation in the degree of accuracy to which measurements are taken would cancel out many of the differences between the two regulations.

MEETING IN GLASGOW

2nd DECEMBER, 1958

To Mr. A. Hislop

Mr. Hislop's reference to electricians' stores illustrates yet another example showing that the tonnage rules have not kept abreast of modern ship and engine construction. In the example and under the circumstances quoted, we would agree that an allowance would be warranted.

With reference to the sister ship, it is suggested that where a Surveyor has to deal with a ship, the sister of which has already been measured for tonnage by the Society, then he inform London Office accordingly before commencing the measurement, requesting a copy of the sister ship's tonnage computation for guidance.

The comment that since the innovation of the new ruling for propelling power allowance for ships up to 13 per cent of the gross tonnage the old rule of $1\frac{3}{4}$ times the tonnage of the actual machinery space no longer applies, is not quite correct since this ruling still applies in certain cases.

Examination of the amendment to the Act concerned will make this clear.

The amendment to the British Tonnage Rules was approved on the 1st July, 1954, and applies to "small engine rooms", i.e. an engine room the tonnage of which is less than 13 per cent (paddle ships 20 per cent) of the gross tonnage of the ship. In respect of all ships in this category the allowance is 32/13 (paddle ships 37/20) times the tonnage of the actual engine room space.

In the case of a ship, the keel of which was laid prior to 1st July, 1954, the Owner, on request, can have the propelling power calculated in accordance with this amendment.

However, if in any ship in this category, a Surveyor is not satisfied that the space provided for the working of the boilers and machinery and the ventilation and lighting of the spaces is not adequate, then if the keel was laid *after* 1st July, 1954, no deduction whatever may be allowed, and for any other ship the deduction shall be $1\frac{3}{4}$ (paddle ships $1\frac{1}{2}$) times the tonnage of the actual engine room.

The amendment to the U.S. Tonnage Rules was approved on the 4th June, 1956, and is identical to the British Amendment except for the last paragraph, starting—However . . . .

When reading both the British and U.S. Rules, some confusion may arise. The former states that where the tonnage of engine room is less than 13 per cent of the gross the allowance shall be proportionately reduced—for a 12 per cent engine room would receive an allowance of $12/13 \times 32$ per cent of the gross, whereas the latter state that in such case the allowance should be $32/13$ times the actual engine room tonnage.

The following shows that these two allowances are, in fact, exactly the same.

$$\frac{\text{E.R. tonnage}}{\text{Gross tonnage}} = x\,\% = \frac{x}{100} \therefore x = 100\frac{\text{E.R. tonnage}}{\text{Gross tonnage}}$$

per British Rules allowance

$$= \frac{x}{13} \times \frac{32}{100} \text{ Gross tonnage}$$

substitute for x

$$= \frac{\cancel{100}\text{ E.R. tonnage}}{13\,\cancel{\text{Gross tonnage}}} \times \frac{32}{\cancel{100}}\, \cancel{\text{Gross tonnage}}$$

Allowance $= \frac{32}{13}$ E.R. tonnage as per U.S. Rules.

To Mr. D. S. Forsyth

As can be seen elsewhere in this reply, an index of the paper has been compiled at Mr. Forsyth's request.

Mr. Forsyth is quite correct in stating that the American Coast Guard Authority issues an Appendix to the Tonnage Certificate which states the tonnage of passenger spaces which have been exempt from measurement. This enables other authorities to make adjustments to the tonnage figures for the purpose of dues, etc. This Appendix only applies to vessels sailing under the American flag, and is not required for passenger ships sailing under the various flags of countries for which the Society is authorised to measure tonnage.

Regarding stabilizer compartments and the space for Suez Canal searchlight, it seems reasonable that these could be deducted as navigation spaces.

It is also correct to say that baggage rooms as such are not deductible, though it is obvious from Mr. Forsyth's remarks that certain "dodges" are employed to ensure this deduction. It is also worthwhile to state that no allowance is given for provision rooms under the U.S. Rules, whereas under the British Rules an allowance is given.

It is of particular interest to note Mr. Forsyth's mention of rounded gunwale sheer. The case referred to was dealt with on its merits as stated. Similar cases would, no doubt, receive special consideration in London office.

Mr. Forsyth raises a point about the notification of alterations to an existing ship. If the ship carries a tonnage certificate which was issued by the Society, then if such alterations affected the tonnage measurement it would be prudent to inform London office. Regarding Mr. Forsyth's remarks about actual measurement on the ship, we would refer him to our reply to Mr. J. Todd.

To Mr. W. T. Burns

We would confirm that 'tween deck spaces should be treated as one unit, irrespective of the treatment of the underdeck. We would refer Mr. Burns back to the fourth paragraph of Section 10 of the paper, where it is stated that if the underdeck has been measured, then the 'tween decks should be treated as one unit and, depending on its length, be divided into an even number of equal parts as required by Table I, paragraph 2.

With regard to the preference between measurement at ship or from the lines plan, we would refer Mr. Burns to our reply to Mr. J. Todd.

Referring now to the comments concerning measuring the ship in conjunction with the National Authority Surveyor.

In the conclusion to the paper we recommended this where possible so as to prevent any major differences in the tonnage measurement figures occurring: e.g., if the figures differed due to the differences in the respective tonnage regulations, then this can be satisfactorily explained. However, if the difference occurred in the underdeck, say up to 50 tons or so, then even allowing for the small differences which are bound to arise when the measurement is done independently, a satisfactory explanation would be hard to come by. Hence, by consulting with the Surveyor to the National Authority at the time of measurement, the final computed tonnages would be comparable.

The main point raised by Mr. Burns with regard to carrying out the measurement in conjunction with the Surveyor to the National Authority, concerns the underdeck measurement.

First of all, let us state that measurements carried out by other National Authorities have been accepted by the Society in certain cases. Usually due to the fact that the ship concerned had changed her flag and in the time available a complete measurement in accordance with the U.S. Rules was not possible. However, what must be borne in mind is that the Society issues tonnage certificates on measurements taken in accordance with the U.S. Tonnage Rules, and if there is time and means available (especially with regard to new construction ships) then these rules should be adhered to.

We certainly appreciate Mr. Burns' point that a lot of time would be saved by accepting a British Measurement, say, and then the Surveyor need

only be present at certain times sufficient to take check measurements. We are of the opinion that, even if the measurement is carried out in conjunction with a Surveyor to a National Authority, then the underdeck measurements should be such that the T1 form could be filled in by the Society's Surveyor in accordance with the U.S. Rules.

To Mr. J. C. Brown

With regard to the "dynamo spaces" we would refer Mr. Brown to our reply to Mr. Marsden, and for short-cut methods when measuring open/closed shelter deckers, we would refer him to our reply to Mr. J. R. Cheshire.

Mr. Brown has raised the controversial question of standards in crew spaces in connection with tonnage admeasurement, and points out the important fact that the Surveyor is required to sign a declaration given on the T2 form stating that the crew spaces concerned fully comply with the provisions of the recognised crew space standards. First of all we must make it quite clear that none of the countries on whose behalf the Society is authorised to issue tonnage certificates have laid down any regulations as to standards acceptable in crew spaces.

What these countries have stated, however, is that they require the tonnages of their ships to be computed in accordance with the U.S. Tonnage Regulations and this being so, then the references to crew spaces in these regulations should be applied. Briefly these regulations state that any space housing members of the crew should be securely constructed, properly lighted, drained, heated and ventilated, properly protected from weather and sea, and, as far as practicable, properly shut off from the effluvium of cargo or bilge water.

As can be seen, this gives an overall picture of what the crew spaces should comply with, but nothing in detail. It is recommended therefore that, in order to clarify and apply the standards given in the above statement, the standards as laid down in the M.O.T. Crew Space Regulations should be used as a guide.

If, in the examination of any new space, any obvious digression from the purport of the above is discovered, then the space in question should be disallowed as a deduction from the gross tonnage and details and reasons why so disallowed given on the T2 form. In any case where this action is necessary, it is recommended that the owner be notified accordingly and reasons given why the spaces concerned have been disallowed. In such cases it is considered advisable to consult London office before any action is taken.

To Mr. W. R. D. Saxton

The question raised by Mr. Saxton regarding the Society's attitude of making the tonnage computation available to owners is really a matter of policy and as such does not come within the scope of the paper. We can only surmise, however, that the attitude adopted by the Society is similar to that adopted by the United States Tonnage Authorities who have made it clear to the Society that their final computations are private and confidential, for their own use only.

We can suggest, however, that should a similar situation arise, then it should be pointed out to the owner concerned that under the laws of the United States relating to the measurement of vessels, the tonnage certificate has to be countersigned by the owner, master of the vessel, or by some other person who shall actually attend her measurement on behalf of her owner or owners, in testimony of the truth of the particulars contained on the tonnage certificate.

In this way, the owner has no justifiable argument that because he does not sight the final computation of the Society he cannot sign the tonnage certificate as being a true record as the decision as to the authenticity of the particulars remains with him by having a representative at the actual measurement.

With regard to the question on crew space standards, we would refer Mr. Saxton to our reply to Mr. J. C. Brown.

It is for safety reasons that the sliding rail in Fig. 13 is box ended. The gallows crane arrangement shown by Mr. Saxton is very interesting, but it would seem most unlikely that it would be accepted by either the British or U.S. authorities because of the permanent attachment of the hinges to the bulkhead. This is an example of a drawing which would have to be submitted to the National Authorities concerned for their consideration.

To Mr. R. G. Lockhart

The after terminal of the register length under the British Rules in vessels having no sternpost is taken to the fore side of the rudder stock and not the rudder trunk as stated in error in the paper.

The allowance for ceilings is a maximum of 3 in. even in the case of ore carriers mentioned by Mr. Lockhart.

In cases where a vessel has deep double bottom tanks, one-and-a-half times the rule depth of double bottom is generally taken to be a double bottom tank ; above this height it becomes a deep tank. Cases of this kind are treated on their merits, and it is advisable to consult the London office before carrying out the measurement.

Mr. Lockhart's query regarding the term "decided flat" is an understandable one. We can only suggest that if such a flat is measurable then it is a "decided flat".

The height of hatch coaming within the tonnage well is, as Mr. Lockhart says, not a tonnage matter but one of freeboard. It is, however, a fact that a 9 in. coaming with the closing appliances for a hatch on an exposed freeboard deck is acceptable.

We have seen many proposals for easy conversion from "open" to "closed" and *vice-versa,* none of them could be termed simple and many of them were rejected because they contravened the

regulations in some way. It must be borne in mind, with the U.S. Rules, that plates are not permissible as temporary closing appliances in the shelter 'tween decks; therefore closing plates used in the closed condition could not be adapted for use in the open condition. Under British Rules temporary plate closing appliances can be adapted for use in the "closed" condition by means of a detachable rubber gasket, subject to classification requirements. The closing of the tonnage hatch presents a different problem, and it is safe to say that under both regulations it would not be possible to design a cover which would suit both the open and closed conditions without a great deal of alteration, as in the open condition there must be no attachments which would enable the cover to be made watertight.

To Mr. F. H. Atkinson

Mr. Atkinson raises the question as to what limits can the shelter deck tonnage opening be reduced?

This applies only to the length of the opening, since in accordance with the U.S. Regulations, the permanent middle line tonnage opening in the shelter deck must be at least 4 ft. 0 in. long in the clear (*see* para. 14 (a) of paper).

Forgetting for the moment the clause relating to the width of the aftermost cargo hatch, let us consider what minimum width would be acceptable.

For exemption of the 'tween decks space, the U.S. Regulations stipulate that there have to be two tonnage openings in each 'tween deck bulkhead of size 3 ft. 0 in. × 4 ft. 0 in. This gives an area of opening of 24 sq. ft. in the bulkhead. Surely then, this reasoning can be applied to the shelter deck tonnage hatch. This hatch is restricted to 4 ft. 0 in. long in the clear and adopting the same area of opening gives a width of 6 ft. 0 in.; therefore we would reason that the minimum size of opening acceptable would be 4 ft. 0 in. × 6 ft. 0 in.

Referring back to the clause concerning the aftermost cargo hatch, if the width of the cargo hatch is greater than 6 ft. 0in., then the width of the tonnage hatch would be increased accordingly, but if the cargo hatch width was less than 6 ft. 0in. then the 6 ft. 0 in. minimum would be applied.

Mr. Atkinson ventures for comment a proposal for abolishing the shelter deck type of ship. Although proposals for new tonnage regulations are outside the scope of this paper, we can, in principle, agree with him that the shelter decker should be made redundant, not because it may hazard the ship's cargo or because of the tonnage dodging, but because it may hazard the ship. The construction of shelter deck ships is well known, whereby the main transverse bulkheads are not always carried up to the top deck, and where they are, their watertightness is jeopardised by the fitting of tonnage openings. In this respect, in the event of underwater damage, it does not require much investigation to show that, in all probability, the ship would sink due to lack of subdivision.

Without further investigation into Mr. Atkinson's proposal, we would say that it appears to be a step in the right direction. His further amendment of making the tonnage of a ship its maximum deadweight again gives food for thought and brings to mind a proposal put forward by an I.N.A. Committee for replacing the tonnage laws by a new system of tonnage measurement based on designed draught and displacement. It may be well to record that such was the feeling against the proposal by Government bodies and shipowners that nothing ever came of it. What we would like to see would be an international system of tonnage assessment with the minimum of measurement and the rules so framed that the shelter deck ship would automatically become redundant.

We would like to point out that an investigation into the whole tonnage measurement system is being carried out by the "Inter-Governmental Maritime Consultative Organisation" (IMCO) and it is believed that the question of the shelter deck ship is on their agenda for discussion.

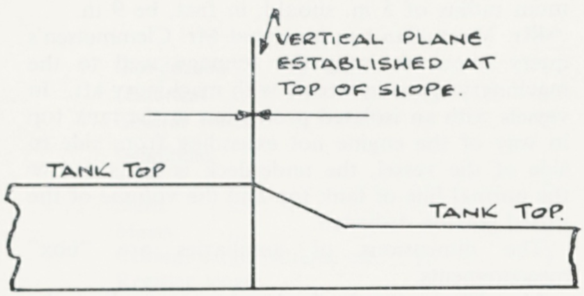
WRITTEN CONTRIBUTIONS

To Mr. J. F. Cheshire (Kobe)

Mr. Cheshire's remarks are appreciated, since he queries certain statements in the paper which, quite possibly, are not clear to those unfamiliar with tonnage measurement, and also contributes to the paper by referring to certain aspects which were omitted. His contributions to the paper on the whole, are perfectly clear, but it is thought that in one or two instances a small sketch illustrating his point would not be amiss.

His point regarding the wording of the paper is appreciated, but as he himself will know, due to his intimate knowledge of tonnage measurement, departing from the official wording can sometimes give a different interpretation of the rules. So as not to mislead those who are not familiar with the tonnage regulations, we decided that where the regulations were directly concerned, we should stick to the official wording. This applies to Mr. Cheshire's remarks regarding the definition of the "tonnage deck" and of "excess hatchways".

He brings out a good point regarding a sloping break in the double bottom and this is illustrated below.



It is agreed that the references to paragraph 16 (ii) and to the statement regarding treatment of passenger cabins, etc., under British Rules are more explicit as given by Mr. Cheshire. The comments regarding the light and air spaces are appreciated. The reference to inclusion of the funnel is adequately expressed by Mr. Cheshire, but it is thought that a small sketch indicating incumbrances in the light and air casings would help to illustrate this point more clearly, so this has been included.

Mr. Cheshire's point regarding the shelter deck type of ship is a good one, and serves to illustrate that the only difference in the actual measurement of the two conditions would be in the underdeck.

If the actual measurement as sailing was for the open condition, then the only additional measurement to be included when submitting the tonnage forms to London office would be an underdeck measurement for the closed condition.

We may clarify our remarks in Appendix II, page 28, by saying that Surveyors need only complete the T 1 and T 2 forms for the condition in which the ship sails plus the T 1 form containing the additional measurements, as given above.

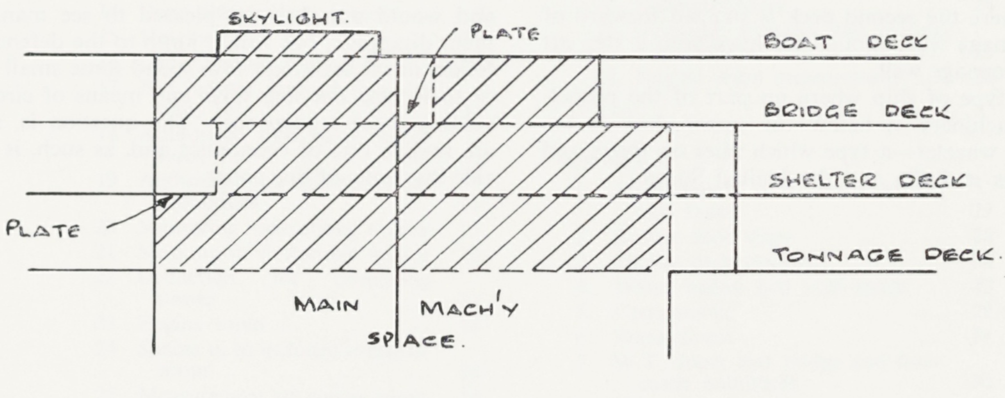
Permanent closing of the 5 in. scuppers in the tonnage well is a freeboard requirement, and usually it is left to the Surveyor concerned how this should be done. In some cases it is acceptable to screw down the non-return valve subject to the control gear being removed.

Mr. Cheshire's other contribution to the paper regarding a passageway in an open shelter decker's 'tween deck is self-explanatory.

We would concur with Mr. Cheshire that in the case of an existing ship where the desired information could not be obtained or the time for a complete remeasurement was not available, then Rule II as set out in the British Tonnage Regulations would be adopted, subject to the owner being informed that this was a temporary measurement only, and that the ship would have to be made available at some later but convenient date for a complete remeasurement to be made.

To Mr. O. M. Clemmetsen (Hamburg)

The Authors are well aware of the anomalies which exist between different tonnage regulations when applied to the measurement of a ship, and in the paper have indicated the main such differences which occur between the British and American Regulations. To comment on why there should be such differences is outside the scope of this paper, and we can only say that until an international system of tonnage measurement is agreed to and adopted by the countries concerned, then these differences will continue to exist.



SHADED SPACES ONLY ALLOWED AS L & A.

Similarly, if the actual measurement as sailing was for the closed condition, then the additional measurements to be reported would be an underdeck for the open condition and a measurement of the exempt 'tween deck spaces plus details and measurements of any closed in spaces situated in the 'tween decks. In either case the tonnages for the open or closed conditions can then be computed.

It is understood that a reciprocal agreement does exist between certain of the maritime countries, whereby the tonnage certificates of each one are accepted by the others. In some cases, although the figures and particulars on the tonnage certificate are accepted, allowance is made for the anomalies existing between the regulations concerned and the tonnage figures adjusted accordingly.

Some owners circumvent this by having their ships carry the tonnage certificates appropriate to the countries between which they are trading.

The reference to the Suez and Panama Canal Regulations is outside the scope of this paper, and in fact, to adequately comment on these differences would virtually mean having to write another paper. We would say, however, that the detailed information and measurements supplied for the national tonnage concerned, is usually sufficient to enable the Suez and Panama Canal tonnages being computed. Each ship, of course, must be treated on its merits, and in cases where this is not possible, detailed instructions would be sent to the Surveyor concerned.

The number of masts is shown on the tonnage certificate for identification purposes in the same way as raked stem and cruiser stern.

Mr. Clemmetsen brings out a good point about the measurement of refrigerated ships, though, as yet, none have been measured by the Society's Surveyor. The underdeck should be measured before the insulation is put in place, and a deduction made for ceiling on the tank top and frames.

In cases where cargo battens are removed after the ship has been in service, it would be in order for the Surveyor to inform the owners of the effect on the tonnage if the ship's tonnage certificate had been issued by the Society.

Mr. Clemmetsen states that in British ships one opening of twice the size of the usual openings will be accepted in the 'tween deck bulkheads of shelter deck ships. We must state that the case referred to was an unusual one and one opening was agreed to in this instance only. It was not intended to give general approval to such an arrangement.

It is difficult to visualise the case quoted of a ship where the second deck is stepped forward of the tonnage well, though we have seen a step aft of the tonnage well.

One type of ship where no part of the propelling machinery is below the upper deck is the quarter wheeler—a type which plies on rivers and estuaries in India and the United States.

As far as is known, the M.O.T. attitude towards radius corners in the deck plating at tonnage hatches is similar to the American attitude stated under Section 14, page 9, of the paper—the maximum radius of 5 in. should, in fact, be 9 in.

Mr. Macmillan has answered Mr. Clemmetsen's query about draining the tonnage well to the machinery space in vessels with machinery aft. In vessels with an isolated protrusion in the tank top in way of the engine not extending from side to side of the vessel, the underdeck is measured to the normal line of tank top and the volume of the raised portion deducted.

The dimensions of auxiliaries are "box" measurements.

Mr. Clemmetsen's final query regarding the principal differences between the British, American and the International Regulations has, we feel, been answered by Mr. Marsden.

To Mr. J. Wormald (Cardiff)

Mr. Wormald's remarks about the difficulties of placating irate superintendents sometimes have their parallel in London office, and we can therefore be truly in sympathy with him. As to the number of decimal places to be shown on various certificates, it is difficult to lay down a hard and fast rule on this as different countries have different requirements. We would suggest that, to be on the safe side, the tonnage should be given to the second decimal place.

The query about the arrangements described in Mr. Sarginson's paper would seem to have been adequately answered in the discussion to that particular paper.

We have a certain amount of sympathy with Mr. Wormald's closing comments regarding the anomalies which exist between various regulations and would ourselves be pleased to see many of them disappear, but would jump to the defence of fellow naval architects who spend some small part of their time devising ways and means of circumventing these regulations. The question is, after all, mainly one of economics and, as such, is outside the scope of this paper.

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PRINTED BY LLOYD'S REGISTER OF SHIPPING
AT GARRETT HOUSE
MANOR ROYAL, CRAWLEY, SUSSEX, ENGLAND

Lloyd's Register
Staff Association

Session 1958-59
Paper No. 3

SOME NOTES ON ENGINE REPORTS

by

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The Author of this paper retains the right of subsequent publication, subject to the sanction of the Committee of Lloyd's Register of Shipping. Any opinions expressed and statements made in this paper and in the subsequent discussion are those of the individuals.

Some Notes on Engine Reports

By E. L. Knowles

Engine Reports Department is the last link in the chain before the Committee. It follows, therefore, that we have to be critical in our examination of reports.

There are some who think our criticisms are little better than annoying pin-pricks, but I would remind you that, in addition to the necessity of ensuring that all is in order from the Classification angle, these reports are legal documents and may have to be produced in court if litigation takes place. Clarity should therefore be one of our watchwords, because an ambiguous statement would be questioned by opposing Counsel and the value of the *whole* report placed in doubt.

We have, however, a further duty and that is to be helpful and to give advice to our colleagues as may be necessary, and it is with this in view that these notes have been written. I sincerely hope they will be received in this spirit.

The experience to be gained in our Department is invaluable, and I strongly recommend any of you who may be offered the chance of a few months with us to accept it.

We would welcome a visit from anyone passing through this office, believing that the more we get to know one another the better it will be for the Society and for the retention of the "family spirit" which is so important.

We deal with some 30,000 reports per annum and a recent census showed that in a period of 12 months, further information had to be sought from our colleagues in about 20 per cent of the cases, i.e., about 6,000 queries and 6,000 replies. A large amount of this could have been avoided if sufficiently clear information had been given on the reports. Subjects of class are sometimes recommended without any indication of the reason for it. Information is sometimes lacking to show what arrangements have been made to deal with an outstanding item or for the completion of a survey.

Memos and letters regarding overdue surveys or the expiry of a limit often cause unnecessary correspondence. It is useless to tell us that these matters will be dealt with at first opportunity or some such phrase, and you should therefore always endeavour to obtain a concrete proposal from the owners.

Owners often ask for extension of a limit on some item or other and, when looking into the case, we find that the man who sends in the owner's request was the one who imposed the limit or who last examined the item. In such cases we expect him to add his own observations as to the merits of the request and not to be content to act as "postman".

I have, as you will see, tried to deal with each report form separately because this seems to be the simplest way. In recent times, new report forms have been introduced, not only to try to bring things up to date, but in an endeavour to set forth the requirements in a clearer manner and to avoid ambiguity of statements. Nothing is perfect in this world, but I do suggest that our latest report forms are a vast improvement on the old ones and, when properly written, reduce the work of reporting and checking.

FIRST ENTRY—GENERAL

A number of new report forms have recently been introduced, and it is hoped they will achieve something which has been lacking for a long time—full information.

This may not be immediately clear to some of you, especially those who have not worked in Head Office, so I will make a few illustrations.

Questions are sometimes asked about the machinery of an existing vessel not of very recent construction, and it is most annoying to find that that particular point was not catered for on the F.E. Report, or was not shown on the plans or was not mentioned in the correspondence.

We are sometimes asked by cable for the minimum Rule size of shafting. As you know some small allowance can be made if the actual tensile strength was above the Rule minimum. To determine this involves searching for the appropriate Forging Report which might have been lost, so we now ask for the minimum approved U.T.S. to be stated in the report.

The new forms ask more detailed questions regarding pumping arrangements. This is, of course, because we need the information, but it also has the effect of minimising the many interpretations which were placed on the requirements of the old forms.

In first entry work generally, it often happens that alterations are made from what is shown on the approved plans. Rule requirements may still be covered but, in order to ensure that a true record is made, it is necessary to forward an "as fitted" plan with the report. It is, however, a serious waste of time to open an "as fitted" plan

of piping arrangement or electrical circuits and find no clue as to where the amendments have been made. It will, therefore, be appreciated if you will make suitable notes or marks on the plan as necessary and mention the existence of this plan on your report.

Many Surveyors send us a simple or diagrammatic general arrangement plan with their First Entry Reports showing the whole of the plant in the engine room. This is most welcome, especially with steam turbine driven vessels for which we are still using the old report forms, and it would be appreciated if this were made general practice throughout the world.

We sometimes find that scantlings are reported in inches, whereas the approved plan is in millimetres. Conversion to inches is wholly unnecessary and wastes the time of everyone concerned.

Plans sent in from abroad for consideration *without* translation frequently cause delay in Head Office, followed by cables urgently requesting approval.

We do our best with all languages, but the fact remains that delays will be considerably lessened if one copy of each plan can be translated before forwarding to this office.

It should be noted that the date of approval of plans, torsionals, etc., is the date of London letter of approval. This is a small point, but it can cause trouble if reference is required at some future date.

MOTOR SHIPS

The description of the main propulsion system is, I regret to say, often reported incorrectly. It is essential to state whether the engine is directly coupled to the intermediate or propeller shaft, or whether there is a flexible coupling, oil operated clutch, hydraulic coupling, clutch and gearing or whether the gearing is simply a reverse system. There are even cases where the colleague at the installing port has merely referred to a report from another port which, in point of fact, dealt with a bare engine only.

In describing the cooling system for cylinder jackets, it is obvious that the Surveyor who is concerned with the building of the engine may not know the full answer but, when reporting the installation on board, care should be taken to state whether "fresh" or "salt" water is used.

Particulars concerning superchargers are often omitted from First Entry Reports.

It often occurs that an engine is approved for a certain b.h.p. but is only intended to be used at a lower—or service—b.h.p. This service b.h.p. is of no interest to us from the point of view of assessing the machinery numeral, being solely an owner's arrangement, and Surveyors should always state the maximum b.h.p. for which the machinery has been approved. Bear in mind, however, that the engine may be approved for a higher power than the straight shafting, in which case the latter power should be quoted.

Remember to state whether the engine is secured direct to the tank top or to a built-up seating.

With regard to air compressors and air receivers, you are asked to state the number of the certificate concerned and the port of issue, and it is not sufficient to quote the serial numbers of these items.

Under the heading of "Main Engine Driven Pumps" you are asked to state the number and purpose. Please make it clear whether the cooling water pumps are for "fresh" or "salt" water or both. There are some cases where these pumps are also connected to the bilge service, and this information must be given.

When filling in the particulars of Steam Installation I would remind you that an exhaust gas boiler which can deliver steam direct to range is considered to be a donkey boiler. (Note that the phrase "direct to range" does not include cases where the oil fired boiler is used as a steam receiver, its burners not being used.) If, however, it is used as an economiser in conjunction with an oil fired boiler, care must be taken to see that it has been approved for at least the same working pressure as the donkey boiler it works with, and that its relief valves are adjusted accordingly. Cases have been known where an economiser has been approved and built at another port for a pressure lower than that of the donkey boiler it is intended to work with. This is not the fault of the Surveyor concerned but, as soon as it arrives at the installing port its marks and certificate should be checked. If necessary, Head Office should be contacted immediately so as to deal with the matter before the trial trip.

TURBINE VESSELS

Please note that the "diameter at wheel shroud" is not the diameter of the wheels.

The particulars required to assess the total heating surface of boilers for Register Book purposes still cause difficulty. In some cases the information is not shown on approved plans but, in any event, the figures required are:—

Total generating surface including waterwalls

Total superheater surface

Half the total economiser surface

and it will be appreciated if these items can be stated separately.

It is important to state whether "Steam Generator" for supply of low pressure steam has been fitted and its approved working pressure, also to what pressure its safety valves have been set, but I regret to say this sometimes only comes to light from the certificate of manufacture.

Safety valves on boilers are often described as "2-enclosed spring". This gives no clue as to whether the valves are of "ordinary", "high lift", "improved high lift" or "full bore" type, and I am sure you will, on reflection, realise that this information is essential in deciding whether the size and number of valves is sufficient.

ELECTRICAL REPORT 13

I have only one point to mention.

On the first page you are asked to state the positions of the generators and switchboard. We have often been told that the generators are "in the engine room" and that the switchboard is "near the generators". Such an answer is, to say the least, unhelpful.

REPORT 9

The introduction of the new form a short time ago was done in an attempt to produce more uniformity in reporting as well as to reduce writing and descriptive matter, and I think it has largely succeeded.

There are, however, a number of points which deserve mention. We still find cases where "No. 5 unit" of the main engine has been "examined throughout". This is vague and we have to enquire how much has actually been seen. After all, spaces are provided for cylinders, etc., top and bottom ends. Similarly, to say that "Nos. 1—6 cylinders, etc.", have been examined leaves a doubt whether all six or only Nos. 1 and 6 were seen.

We often find instances of Docking Surveys where the weardown of the sternbush is not reported. I realise that where an oil gland is tight and appears to be otherwise in good order, there is a reluctance to disturb it, and this matter is covered in Instructions to Surveyors.

In the case of ordinary water-lubricated bushes, however, it is somewhat different. Owners often ask for deferment of a screwshaft survey beyond the due date, and knowledge of the amount of weardown at the last survey is very useful in assessing the merits of the proposal.

We still find evidence implying that the rules concerning oil burning plant for boilers are not clearly understood. This plant has to be examined *under working conditions* at Boiler Surveys, but the oil pumps and heaters are amongst the essential fittings of the vessel and must be *opened out and examined* as part of the Engine Survey or Continuous Survey. In some small installations the oil supply is of a gravity type with no pumps or heaters, and we would appreciate a statement accordingly, thus leaving no element of doubt whether the survey is complete in this respect.

We are required to identify essential auxiliary machinery by its position on board, and the need for this will be readily understood if accurate records are to be kept of the survey position. Unfortunately, earlier records in this office are not always clear, and on more than one occasion it has been found that machinery has been added or removed at some previous date without being reported. It will help us considerably if, when reporting an item of which there is only one on board, e.g., ballast pump, this point is made clear.

Where, however, there are more than one of a certain item, a clear indication of its position is essential (*see also* remarks on Report 18). Too often are we told, for instance, that the starboard generator engine has been examined, when we know that the vessel has a starboard inner and a starboard outer set.

We sometimes note that an "auxiliary cooling water pump" has been examined, and we are left in doubt whether this refers to a pump expressly for cooling generator engines or whether it is, in fact, the standby pump serving the main engines.

Surveyors often report having examined sanitary pumps and fresh water pumps. Pumps on domestic services only are not part of classification and need not be examined. Care should be taken, however, to see that *all* pumps having connections to essential services are examined as part of the Special or Continuous Surveys. These may on occasions include the sanitary or fire/deck wash pumps, or even the Butterworth pump in the case of tankers.

"Harbour" generating sets are sometimes rather loosely described. Some of these sets are of very small capacity and can only be used for lighting purposes, etc., in port. As such, they are not a classification requirement and need not be examined. Some, however, are of greater capacity and are so connected to the main switchboard that they could usefully take over some of the essential load at sea. Such sets should be included in the items to be examined at Special Surveys.

"Emergency" generating sets do not require to be opened out at Special Surveys for classification purposes. There are, however, some instances where "harbour" and "emergency" sets supply power to, or directly drive, an air compressor for first charging air receivers in a "dead" ship. These become part of essential plant.

Whilst on this subject, I would refer to the case of the breakdown of one of the generator sets. The records in Head Office do not always show, with any degree of accuracy, what the total load is at sea for essential purposes. This can more readily be assessed by the man on the job and is a necessary part of his survey, so as to decide whether this load can be carried by the remaining generators, plus a standby set as required by the Rules. Suitable remarks about this should always be made on reports.

In deciding what the total load is, one should include the following:—

Fresh and salt water cooling, Lubricating oil, Steering gear — but not the standby units
One air compressor
Essential lighting

The power required for bilge and ballast pumps has been omitted from this list, since the power absorbed by an air compressor—used only when manœuvring—is usually greater than that of such pumps.

These remarks certainly apply more especially to motor ships, but should be applied, as appropriate, to steamers.

Where the vessel has a R.M.C. plant classed with this Society and there is refrigerated cargo on board, you should find out how many compressors, brine and water circulating pumps and cargo fans are necessary at sea, and exclude the standby units which, as their name implies, are intended for use in emergency. "Hotel" services, non-essential lighting and domestic refrigerating plant are not included.

I think the most troublesome cases under this heading are vessels which have only two generator sets. When one breaks down, there is only one machine left and no standby. In some instances, owners have arranged for a diesel generator set to be temporarily fitted until repairs can be carried out. If, however, suitable arrangements of some sort or other cannot be made, you should cable Head Office for instructions before issuing an Interim Certificate (*see also* page 10—Instructions to Surveyors Part 3b).

In very large passenger ships, which naturally have a heavy "hotel" load, the total generating plant on board is probably much in excess of what would be required for essential services. Breakdown of one generator set may, therefore, not affect classification requirements, and it is then considered the vessel's class need not be made "subject" to this set being repaired. A note can be made in the S.R.L.—Appendix.

Care should always be given to the phraseology used in describing defects. This is important at any time, but especially if postponement of re-examination of repairs after the due date is requested.

We, in Reports Department, are frequently left in doubt as to the true state of parts examined, due to the casual manner in which defects are mentioned. We are often told that something is somewhat worn, boiler furnaces somewhat distorted, tubes of water tube boilers somewhat sagged, ship's side valve chests somewhat corroded, screwshafts somewhat corroded and so on, without any statement as to whether the part concerned is considered to be efficient until the next normal survey as required by the Rules, or whether it should receive attention by some specified time.

Where items are showing signs of defect but are efficient until the next regular survey, such as next Boiler Survey, they will be recorded in the S.R.L.—Appendix as italic notes, and you should recommend accordingly.

Where, however, you consider that further attention should be given by a specified time, the matter becomes a "subject of class" and should be so stated on the Report and Interim Certificate, and a Letter Form 4 forwarded to the owners in all such cases.

Whenever a subject of class is amended or deleted, due mention should always be made in the recommendations on Reports and Interim Certificates.

When safety valves of boilers have been adjusted, care should always be taken to make it clear whether all boilers have been thus dealt with, or only some particular boilers.

Motor ships often have exhaust gas economisers as well as donkey boilers, and it should be borne in mind that the economisers and their circulating pumps are part of the Donkey Boiler Survey.

Cracks in castings are nowadays frequently repaired by the "Metalock" process. Where such repairs have been effected to items of importance, however, they are not considered to be permanent until they have been re-examined after an appropriate length of service and found to be intact. When effecting such repairs, therefore, the class should be made "subject" to the repair being re-examined by a specified time.

When a vessel is examined afloat after alleged grounding, it is not sufficient to recommend on a Report 8 that it be specially examined at the next drydocking. Suitable reference to the propeller and outside fastenings being examined should also be made, and you should ascertain from the Chief Engineer whether the machinery and steering gear functioned satisfactorily after the casualty.

Vessels are sometimes drydocked a very short time before the Screwshaft Survey becomes due. In these circumstances, it is the duty of Surveyors to draw the owners' attention to the fact and, if the survey is not carried out, to make due mention on their Report to the effect that owners were advised.

The actual survey of screwshafts calls for great care since cracks are often of a hair-line nature. Some indeed are only revealed by means of one or other of the testing methods in use today, such as the "Magnaflux" system. Sometimes these cracks seem to have disappeared after a certain amount of careful filing and re-application of "Magnaflux" testing, but I must confess I am not at all convinced that this proves that all the defect has been removed, since we know that some of these defects have reappeared at a later date. I

think it would be prudent in such cases to recommend a re-examination of the affected part after, say, a further 12 months' service. These defects mostly occur at the large end of the cone, and this can normally be dealt with by backing-off the propeller. Surveyors should, therefore, make this clear to owners' representatives and on their Report. (*See also* Instructions to Surveyors, Part 3b, page 25.)

A large number of screwshaft failures have occurred on "Liberty" type vessels, and the Society has formulated recommendations to obviate recurrence of these failures. In many cases owners appear to have complied with these recommendations by fitting a propeller which will absorb full power at about 66 r.p.m., provision of an efficient governor and avoidance of racing in heavy weather as far as possible. When a cracked screwshaft is found on one of these vessels, therefore, I think a few judicious questions to the owners' representative as to what precautions they have taken would not be out of place.

Whenever a propeller is changed on a motor ship which has a torsional endorsement, you should state whether the new propeller has the same particulars and materials as the original. If not, every effort should be made to obtain its moment of inertia. This is important because of the possibility that a change in the torsional characteristics may occur.

The phrase "subject to . . . ." is often wrongly used. It applies generally to a defect which requires further attention and should not be used in connection with an incomplete survey. To give an example, it is wrong to recommend a record of "MBS 7/58, subject to the safety valves being adjusted". The correct wording would be ". . . . will be eligible for the record of MBS 7/58, when . . . . ".

Damage Reports are still occasionally received wherein a categorical statement has been made regarding the cause of damage. This should never be done. You should at all times say that the damage was "alleged to be caused by . . . .". Your personal opinions, if at variance with the stated cause, should be dealt with in accordance with Instructions to Surveyors, Part 5, Clause 12.

Recommendations on Reports and Interim Certificates should, at all times, be identical with one another, and the utmost care should be exercised to attain this end.

With regard to Continuous Survey Interim Certificates, I must draw your attention to the very considerable amount of time which has to be spent in this department in checking whether Report and Certificate agree as to the items examined. All too frequently, they do not agree and this involves correspondence so as to establish the facts. Errors and omissions are often the cause of disputes with owners as to whether a Continuous Survey cycle is complete or not. I think you will agree, after a moment's reflection, that it is not to our credit that so many discrepancies occur. At the same time, every effort should be made to persuade owners to keep proper records on board where this is not already done.

It is essential for Interim Certificates to be issued in sufficient time to arrive on board before the vessels sails. Some of you achieve this when the vessel is sailing at short notice by carrying a few blank forms with you and filling them in on board, and there is no objection to this procedure.

Whenever arrangements have been made to advance or complete a survey or deal with essential repairs at a particular port, the Surveyors at that port should be advised immediately by letter or telegram, and a brief note to this effect should be made on your Report. Failure to carry out this requirement has, in the past, been the cause of serious misunderstanding with all concerned.

You may get the impression from these notes concerning Report 9 that we are asking for a lot more information and therefore a lot more writing. This is only partly correct, but I do submit that the information we require is essential for one reason or another. On the other hand, we are not the least interested to read that a number of pumps have had their rods skimmed and the neck and gland bushes renewed. These and kindred repairs can well be collected together and reported as "General overhauling effected as required".

R.M.C. GENERAL

There may be some who are inclined to look down upon R.M.C. work, but I would remind you that this is a separate classification in itself and should receive at all times as much care and attention as the ship and its machinery.

New Rules were brought out in 1955, but it has taken a long time and much correspondence to ensure that survey requirements are properly carried out.

REPORTS 17A AND B

These new forms are a radical departure from the old ones. You are now asked for considerably more information but the object aimed at is to have as complete a picture of the whole installation as possible, and to have it readily available instead of having to "wade through" a pile of plans and correspondence. Nowadays, plant and arrangements are often more complicated than previously.

Vessels built before the last war seldom had a temperature qualification, and therefore gave no true indication of the capability of the plant. Of recent times owners have been enquiring whether, for example, they can carry lower temperature cargoes in certain chambers. Such enquiries have sometimes been difficult to deal with because sufficient detailed information of the installation as originally fitted was not available.

When sending R.M.C. First Entry Reports to Head Office, it will considerably help us if all necessary documents, such as certificates, are sent with these Reports and not bundled in with papers relating to the hull or propelling machinery. The R.M.C. Reports are dealt with, and eventually filed away, quite separately from the remainder, and some of you who have had experience of Head Office will know the time that has to be spent searching for some missing certificate, etc.

I have mentioned under the heading of "First Entry General" the matter of "as fitted" plans. It applies equally well to R.M.C. work.

On page 3 of Form 17B you are asked to state, amongst other things, the number of water circulating pumps. Many installations have only one such pump expressly for the R.M.C. plant, but the Rules require connections to be provided from a standby pump. Please state whether this has been done.

In the "Particulars for Register Book" you are asked to state what are the prime movers. This refers to the method of actually driving the compressors. If the compressors are electrically driven the answer is "Electric Motors" and not "3 diesel generators and 1 turbo generator", since the latter provide the motive power to the prime movers.

REPORT 18

The new form has been laid out far more clearly and in greater detail than the original, and saves a lot of writing. It also serves to give a guide to the Rule requirements, but, even so, there are some points which I will mention. They all refer to the up-to-date form of report, since old stocks should no longer be used.

Under the heading of Repairs and Alterations, it sometimes happens that a major item has been renewed (such as a gas condenser or evaporator). In such cases, it is necessary to state whether the new part is a duplicate of the original in all respects. If not, the plan numbers to which the part has been made must be quoted so that we in this office can make sure the design has been approved for the particular case.

With regard to incomplete surveys, you are asked what arrangements have been made to complete same, and what items are outstanding. The first question is often not answered, but it is of importance, especially when the vessel's present certificate is about to expire, or has even expired.

Where it is known that the survey will be advanced at some specific port this should be stated. The Surveyors at that port should also be advised promptly by letter.

There are still a number of instances where a fresh record of Running Survey has not been recommended because the plant has not been seen under working conditions. We do not withhold a fresh record because of this, unless there are special reasons, since this will be carried out automatically at the next Loading Port Survey. This point is dealt with in Circular 2061 and paragraph N 819 of the Rules.

We now turn to the reverse side of the report form wherein we are required to identify items by their position, and not solely by numbers.

It can be muddling to refer to "Nos. 1 and 2 from aft", and I think a much clearer picture would be got by saying "Both aft. Ship's No. 1 and 2".

You are also asked to state which cargo chambers have been examined. If all chambers have been seen, it is sufficient to say, "all six", rather than to enumerate each one. A case recently occurred where a vessel had eight cargo chambers and it had been reported that Nos. 2, 3 and 4 holds had been examined, which suggested that there were five chambers outstanding. On enquiry, we were told that the Nos. 2, 3 and 4 'tween deck spaces had also been seen. This shows the doubt that can be raised through loose phraseology.

The Rules permit the megger-testing of the electrical plant to be carried out by competent ship's staff or by an electrical contractor. If this has been done, it should be made clear on the Report and not left blank because the Surveyor had not done the testing himself.

It is a Rule requirement that, where only one water circulating pump is provided especially for the R.M.C. plant, a standby pump must also be provided. It follows then that this standby pump should be examined at alternate Running Surveys, but both pumps should be examined at Biennial Surveys. It frequently happens that the standby pump has been examined and reported on Report 9 as part of E.S. or C.S. but that is not enough. Due reference should always be made in Report 18.

A number of Surveyors appear to be in some doubt about the requirements for examination of "shell and tube" type gas condensers at Running Surveys.

The Rules state that Running Surveys may be held *in lieu* of Biennial and Intermediate Surveys. They also state that one such condenser must be examined at Intermediate Surveys.

It follows then that at least one "S & T" condenser must be examined each survey whether it be a Running Survey or an Intermediate Survey, but always with the additional proviso that all these condensers must be examined in any two year period.

Circular 2061 requires that a brief list of parts seen should be stated on Interim Certificates, but this is not always done. Some may query the necessity of this by arguing that the Surveys Book on board has been properly filled in. I regret to say, however, that there are still a number of

vessels which do not maintain such a book. Others keep these records in such a haphazard manner that it would take a long time to assess the survey position clearly.

If the requirements of this circular are carried out, it forms an easy record for owners, also for the Surveyor at the next port of survey. Please note that the list of parts seen should include cargo chambers, megger-testing, etc., and not only the compressors and pumps.

It is necessary to remember also that where a list of outstanding items to complete a survey are quoted, this list may well be correct at the time of the survey. If, however, a period of six months elapses before the survey is completed, it may be that some machinery items are then out of date and further opening up will be required. This is covered by Rule N 849, and illustrates the necessity of keeping proper records on board.

Some Surveyors appear to be in doubt about assignment of a S.R.M.C. Record. Paragraph N 807 of the Rules states, amongst other things, that a record of S.R.M.C. must coincide with a record of Running or Biennial Survey. You cannot, therefore, for instance, have a record of S.R.M.C. 7/58 unless there is also a record of R.S. or Bi.S. 7/58.

It would also appear that some Surveyors believe that a Special R.M.C. Survey takes the place of a Running or Biennial Survey. If you will refer to Paragraph N 852 of the Rules, you will see that the first requirement of a S.R.M.C. is that the Running or Biennial Surveys must have been complied with. Having done this, a Special R.M.C. consists of compliance with paragraphs N 853 to N 865 as applicable.

It might be mentioned at this point that where the insulation of cargo chambers is examined for Running Survey and Special R.M.C. at the same time, due mention should be made on the Report. By this means, doubts as to whether the S.R.M.C. requirements have been complied with will be dispelled.

REPORT 19

The new Report Form for Loading Port Surveys is much simpler than the previous one and should be welcomed by those concerned. The old questionnaire requiring separate answers has been replaced by a list of questions which, it is hoped, will be answered collectively by one little word "Yes". Failure to answer those questions, however, could cause trouble if the Report ever had to be produced in a Court of Law.

The Rules for Loading Port Surveys do not contemplate such surveys being carried out partly at one port and partly at another. On some coastal voyages, however, chambers are sometimes examined for cleanliness at one port. The temperatures of the chambers are then noted and the machinery seen under working conditions at the next port where the cargo is actually to be loaded. In such circumstances, it is the responsibility of the Surveyor at the latter port to satisfy himself that the chambers are still clean and free from damage or odour. This may sound like doing part of the survey twice, and so it is, but it is the only way to ensure that nothing has happened to render the chambers unfit for refrigerated cargo.

Cases have occurred where chambers have been examined at a certain port, but it is not intended to load refrigerated cargo until arrival *in another country*. Such surveys can only be considered as a precautionary measure by owners so as to avoid delay at the loading port by having to effect repairs, and the Surveyor concerned should make it clear on his certificate that a full Loading Port Survey should be carried out at the loading port.

One of the dangers of splitting a Loading Port Survey sometimes occurs in vessels having air circulation in the chambers. Cases have occurred where chambers have been certified clean at one port. During passage to the actual loading port the fans were in use for cooling purposes and, on opening doors to receive cargo, the chambers were found to be anything but clean. Investigation eventually showed that general cargo of a dusty nature had been carried on the previous voyage and that a quantity of dust had, quite naturally, lodged in the air trunks. Someone had unfortunately forgotten to run the fans and clear the trunks before the chambers were submitted for survey for cleanliness. I think the best solution would be for the Surveyor who does the "Cleanliness Survey" to see that the fans are working and to insert a brief phrase on his Report and Loading Port Certificate to this effect.

Where a survey has been held for "Cleanliness of Chambers" only, it should be noted that the vessel's class is not "Subject to the machinery being seen running and temperatures noted". Rather is it a case of "will be fit to carry refrigerated cargo in the above-mentioned chambers when the machinery has been seen under working conditions and temperatures of chambers noted". Use of the word "subject" in this context is not correct, because it usually refers to a defect which requires attention, whereas we are really concerned with an incomplete survey.

Quite recently it was noticed that several surveys for "Cleanliness of the chambers" had been carried out on a certain vessel, but no reports had been received covering the balance of the Loading Port Surveys. The reason for this is not clear, but the onus is, of course, on the owners to complete the Rule requirements. The local Surveyors were asked to explain to the owners that, in the event of a claim being made by them on Underwriters, they might find themselves in difficulties due to non-compliance with the Society's Rules.

There are many instances where Loading Port Survey Certificates have been issued quoting a

record of Running or Biennial Survey which is out of date. As such, they are of little value. I fully appreciate that the latest Supplement of the Register Book in the Surveyor's possession may not be the latest information. In such cases it is necessary for enquiries to be made on board to see whether a valid certificate is in existence. If no such information is forthcoming, the matter should be referred to Head Office immediately, and by cable if necessary, and before handing over the Loading Port Certificate. It is on occasions of this nature that a few well-chosen words to the appropriate people may have the desired effect of ensuring that up-to-date Survey Certificates are available at all times.

General Recommendations on Reports should not mention any particular ports to which the cargo is believed to be destined. This is of no concern to the Society, and, in any case, the vessel may be diverted *en route*. Provided the survey is complete, the printed words are sufficient.

It occasionally happens that, whilst a Running Survey Record is still valid at the time of carrying out a Loading Port Survey, it is obvious it will expire before the vessel arrives at her destination. No exception need be taken since the survey position was in order at the time of loading the cargo.

As I said at the beginning of these notes, they are intended to be a help to all colleagues on outside work, and I want to express my thanks to all in Head Office who have assisted me in compiling them. The trouble with a paper of this sort is that it is never complete. Something will surely crop up tomorrow which should have been mentioned!

Printed by Lloyd's Register of Shipping
at Garrett House
Manor Royal, Crawley, Sussex, England

Lloyd's Register Staff Association

Session 1958 - 59

Paper No. 3

Discussion

on

Mr. E. L. Knowles' Paper

SOME NOTES ON ENGINE REPORTS

LLOYD'S REGISTER OF SHIPPING

71, Fenchurch Street, LONDON, E.C.3

The Author of this paper retains the right of subsequent publication, subject to the sanction of the Committee of Lloyd's Register of Shipping. Any opinions expressed and statements made in this paper and in the subsequent discussion are those of the individuals.

Discussion on

Mr. E. L. Knowles' Paper

Some Notes on Engine Reports

Mr. SIGGERS

I think that this paper on Engine Reports will be of great value to us on the engineering side of the house. We all of us have to write reports and Mr. Knowles, who has been for many years in the Engine Reports Department, is well qualified to give us the benefit of his views and experience.

The figure he quotes on the first page of about 6,000 queries in 12 months is indeed staggering, and seems to indicate that the paper is overdue, but I am quite sure that, if due note is taken of its contents, this largely unnecessary correspondence can be considerably reduced. The necessity for accuracy and clarity cannot be over-stressed and one should bear in mind that, when the Ministry of Transport hold an enquiry into a casualty on a classed ship, they almost invariably call for copies of all reports, and frequently require the Surveyors who carried out the most recent surveys to give evidence. In two recent cases the reports were not accurate; in one, part of the survey which had been done was not reported, while in the other, something was reported which had not been done. One can easily imagine what an uncomfortable experience the authors of these reports might have had in the witness box at the hands of Counsel, had it been in the interest of any of the parties to try to discredit their evidence.

I agree with Mr. Knowles that, when cracks have been ground out of a screw shaft and the shaft passed after a crack-detection test, it is preferable to recommend a further examination after about 12 months in service, unless the crack is a very minor one of no significant depth. There have been two or three cases during the last year or so where, at the re-examination, the shaft has been condemned because either the original crack has gone deeper or other cracks have appeared. It is likely that the ship will dock again in about a year in any case, and provided that they are told of the recommendation at the time, the owners are generally willing to agree to it.

In reporting matters of this sort, I think it is essential to include a simple sketch showing the position, length and depth of the crack.

Mr. Knowles rightly draws attention to the fact that one should not make a definite statement as to the cause of damage in a Damage Report, and perhaps one may mention that, in addition to paragraph 12 of Part 5 of the Instructions to Surveyors, useful guidance is also given in the fourth paragraph of the Foreword to these Instructions.

While on this subject, I think Mr. Knowles might have gone a bit further and pointed out that one should not state one's own opinion as to cause of damage or make any criticism of design in the classification report. Copies of reports are often issued to owners, and with their permission, to other interested parties and, if it is inferred that a damage is due to defective design, it is probable that the owners' claim would not be covered by terms of his policy. Such opinions are welcomed at Head Office, but they should be given separately in a letter forwarded with the report.

On occasion, damage surveys are carried out on the machinery of vessels classed with another Society at ports where that Society is not represented and, after temporary repairs have been effected, the usual Interim Certificate for unclassed ships is issued, but a recommendation is sometimes made that a certain component is to be renewed on arrival at a certain port. In my opinion, the recommendation should only state that the ship, so far as the parts examined are concerned, is fit to proceed to a certain port. Any action to be taken on arrival at that port should be left to the Surveyors to the Society in which the vessel is classed.

I should value Mr. Knowles' views on this point.

It occasionally happens that the Committee, at builders' request, authorise a Surveyor to act as builders' representative at the survey held on a new ship at the end of the guarantee period.

The owners will often have a long list of matters which they consider should be altered or rectified at builders' expense, most of which probably have nothing to do with classification, and it will be necessary to go through this list examining each item in turn. The report should detail what is found and what recommended, but again, no criticism of materials or design must be made, though bearing in mind that the Surveyor is acting as the builders' representative, I think it would be permissible for him to state which items, in his opinion, should be for the builders' account.

Perhaps Mr. Knowles will tell us what he thinks of this.

At this survey, any matters affecting classification should, of course, be reported on Form 9.

Finally, I would thank Mr. Knowles for a very readable and useful paper and, lest they might feel otherwise, I should like to assure our many colleagues whose mother tongue is not English, that due allowance is made for this fact in the Reports Department, as in the case of the report which stated "Nos. 2, 3 and 4 Double Bottom Tanks tested by the undersigned quite tight!"

Mr. HOOK

With the advent of free piston/gas turbine main propulsion and auxiliary machinery installed in ships classed with the Society, it may be

considered of interest to mention that one or two enquiries have been received regarding the type of report required for this type of plant.

In this connection, it will perhaps be of assistance to say that first entry reports for main propulsion free piston/gas turbine machinery and reduction gearing should be submitted on Report Form No. 4b, page 2, with certain additional items on page 1 of that form, under the heading "Main Reciprocating Engines" modified to read "Main Gas Generators", and for auxiliary machinery of the above type, the relevant sections of Report Form 4c should be completed.

Mr. SHIELDS

Engineer Surveyors generally will, I believe, be grateful to Mr. Knowles for the time and trouble taken in preparing this paper. It will surely help to "clear the air" in making known the information required at Headquarters, especially for Classification. There are, however, other facets of the Society's work that should not be forgotten at this time, which are as much the concern of us all. One, particularly with which Chief Engineer Surveyor's Records Department is interested is the supplying of information to assist in Research. Even a minor point, such as stating the material of any particular item of machinery that has failed in service, can be of considerable value in this respect. Circular No. 1991 of April 1952 gives the procedure to be followed in regard to Surveyors' personal opinions.

Regarding loose phraseology (page 6) from the point of view of C.E.S.R., it would be an advantage to report, for example, "Superheaters: 12 corroded tubes renewed" instead of "Superheaters examined and found or placed in good order", but this is not to infer that minor items of general overhaul, as quoted by Mr. Knowles on page 5, should be detailed.

In describing engines, it is helpful if the type is stated, especially in First Entries, e.g., Doxford, M.A.N., Parsons, Pametrada, etc. Couplings, too, could be named with advantage; in fact, anything that can help to locate the maker and type of broken machinery parts would be of service.

I am quite sure that Mr. Knowles' efforts will result in an improvement in the quality of machinery reporting, by bringing to our friends and colleagues in the Outports a clearer idea of what is needed.

Mr. DUNN

This session has enjoyed a wide variety of subjects and all have been greatly appreciated, well received and each filled a need in its own field.

However, none has been looked forward to more than this paper, and it fills a long felt need respecting interpretation of several Rule requirements and the complex problems that are ever arising.

Some will say that the Rules and the circulars are all that is necessary, but experience has shown that these tricky points will re-occur and discussions respecting such problems are good for the Surveyors and for the Society.

Young Surveyors are always inclined to interpret the Rules as they are strictly laid down, and they should not be unduly disturbed if Head Office stretch the requirements "in this instance". At all times cases are dealt with on their merits, but in such cases guidance should be sought.

A young Surveyor should be his own critic and ask himself if he could follow and successfully complete a survey from the information contained in his report.

I would like to know Mr. Knowles' views in respect of the following questions and suggestions:

1. Would the Author not agree to the suggestion that in *commencing or advancing* an E.S. survey the parts examined should be stated on the Interim Certificate B.1. Most E.S. cases are not completed at one survey, and it would serve to ensure the outstanding parts being known at the final survey.

2. *Referring to page* 4—The Author's reference to "defects at boiler surveys considered efficient until the next boiler survey, being recorded on the Special Reasons List Appendix in italics". Does this imply that the boiler in question has to be examined at the next boiler survey date due? i.e., that in such a case, no extension of the 12 months since last examined, be allowed.

3. *"Metalock" Repairs*. The Author states that repairs to items of importance should be "subjects of class", but surely in the case of minor repairs, the "Metalock" repair can be considered permanent? It has been thought that this method of repair has necessitated re-examination solely because the word "Metalock" has been stated.

4. *"Vessel Examined Afloat after Alleged Grounding"*. Does the Author, when referring to the examination of propeller and fastenings at the next dry docking mean that a separate Report 9 should be made, or is it sufficient to be entered on the Report 8?

5. *"Cracks in Screw Shafts"*. The Author suggests re-examination after "say, a further 12 months' service". In such a case as this, would the Author recommend a new T.S. *date* or T.S. C.L. (with date) when the . . . ."

6. *Page 6*. When a new condenser or evaporator has been fitted, the Author will agree that the new unit will not require to be examined until it is eight years old, and that this should be stated when the next S.R.M.C. is reported.

7. If the G.S. pump is examined for C.S. and the *R.S. is not due or advanced*, has a Report 18 to be compiled stating that the stand-by refrigerating water circulating pump (G.S. pump) has been examined?

The reason for this question is to bring to notice the extensive amount of reporting necessary if one item alone is surveyed at a port. This will necessitate an interim certificate C (R.M.C.) stating all the items outstanding to complete the R.S. Could not a cross-reference be sufficient if made on Report 9 stating "for the attention of the Refrigeration Reports Department?"

8. *Page 7. L.P.S. "Cleanliness only".* Where a cleanliness survey only has been carried out, would the Author suggest the wording in such a case that a "further L.P.S. is to be effected at the loading port"?

9. *S.R.M.C.* In cases where a G.E. has been held for postponement of the hull S.S. and the S.R.M.C. survey also deferred for six months, will the S.R.M.C. date be back-dated to the previous R.S.? In the case of a postponement for 12 months, what date of S.R.M.C. will be assigned?

10. In refrigerating plants with three compressors, can a new date of R.S. be recommended if a compressor has not been examined for, say, 21 months? This point is most controversial and causes the greatest of differences.

Mr. Knowles should be accorded our thanks for his splendid effort, and now, a last request—could we not include as an appendix to this paper, several specimen reports with correct and minimum phraseology?

Mr. J. GUTHRIE

A paper on Engine Reports is long overdue and I can think of nobody more competent to present this paper than Mr. Knowles. If, therefore, I take part in the discussion, it is with a view to clarifying certain items of classification which admit of different interpretations rather than to challenge his acknowledged authority on reports.

On page 2, cols. 1 and 2, the Author lays great stress on the type of cooling water used for the main engine and of the pumps required for that purpose. In point of fact, the Rules call for only an "adequate supply of cooling water to the main propelling machinery and essential auxiliary engines . . . ." and the choice of fresh or salt water cooling is left entirely to the owner. Consequently, if the type of coolant is unimportant for classification purposes, why is it essential for the First Entry Report?

While on the subject of cooling water pumps, it is stated on page 6, col. 2, that the Rules require all refrigerating condenser cooling pumps to be surveyed at the Biennial Survey, including the stand-by pump in the main engine room. Thus, a circulating pump of the main engine must be examined every four years, but if the shipowner fits a branch connection to the refrigerating machinery, this pump immediately becomes liable for survey every two years! Can the Author give the reason for this?

Again, in dealing with R.M.C. surveys, the Author mentions in his penultimate paragraph that a Running Survey Record may expire before completion of the voyage, but that the Loading Port Survey will be deemed valid if held before the expiry date. Reading this, one might infer that if an R.M.C. Record expires whilst the vessel is at sea, the owner may consider himself fortunate to retain the class until his vessel reaches port! Surely the dice are loaded against the luckless owners of refrigerated ships . . . . are they not entitled to a period of grace in the same way as they are for engine and boiler surveys?

Basically, the examination of a Refrigerated Cargo Installation is the easiest, cleanest and most pleasant in the whole catalogue of periodical surveys: there is nothing highly technical about the simple compressor circuits, a brace of rudimentary pumps, some piping and some insulation. Why then is as much space required to explain R.M.C. surveys as is devoted to all the other machinery surveys lumped together? On page 7, col. 1, for instance, it is stated that a record of S.R.M.C. 7/58 cannot be assigned unless there is also a record of R.S. or Bi.S. 7/58. If all the requirements of an S.R.M.C. survey have been carried out, can the Author explain why the appropriate record cannot be assigned?

Mr. ARCHER

I think the Association is to be congratulated on this valuable addition to its transactions, and Mr. Knowles thanked for his excellent and informative paper. It is not a very long one, but it surely crystallises an accumulation of wisdom resulting from many years of examining engine reports.

On the subject of Surveyors giving inadequate information in their reports, I suppose, in general, they endeavour to confine their written remarks to the bare minimum, presumably in the belief that what is not stated cannot be criticised, that is to say, "Least said, soonest mended!" This is to some extent understandable, even laudable, but obviously if carried to extremes, it can lead to delay and misunderstanding.

Concerning minimum Rule sizes of shafting, I take it Mr. Knowles now asks for the report to state the minimum of a specified and approved range of tensile strength of the material, so that, failing the actual test results from the forging certificate, some allowance may nevertheless be made. At least, that is how I interpret Mr. Knowles' remarks on this point.

The question of a diagrammatic general arrangement plan of the engine room is one which I regard as important. It would be most useful for reference purposes, and might well, in time, become a requirement of the Rules.

At a recent meeting of the Technical Committee, some progress in this direction was made. It was decided to call for an arrangement plan showing the layout of engines, gearing, shafting, etc., to be forwarded for reference purposes when submitting the machinery plans. I feel sure this will do much to facilitate our work in Engine Plans and Torsional Departments.

I agree with Mr. Knowles that omission of translations on foreign plans can cause delay and even errors, but I venture to suggest that equally time-consuming and misleading are loose translations of builders' letters. A good many of these are highly ambiguous, if not downright misleading. If Surveyors on foreign service would only take the trouble to enclose with the translation a copy of the builders' original, this would save much head-scratching at Head Office.

On screw shafts reclaimed by filing out of fatigue cracks, it should be recognised that this does not by any means guarantee that a recurrence will not take place later, and, as Mr. Knowles points out, to recommend a "12 months' subject" on such "repaired" shafts would be a reasonable and, in my opinion, fully justified precaution. The point to remember is that steel, when previously overstressed by cyclical loading, will have its fatigue strength reduced below its original, or virgin, fatigue limit, even though a crack may not yet have appeared. This, of course, is termed "fatigue damage" and there is as yet no known test for determining when a piece of steel has suffered from such a degree of fatigue damage.

Thus, fatigue is much more insidious than static loading where, at least, evidence of permanent strain can show when overstressing occurs.

On the question of "Liberty" ship screw shafts, it would be useful if Surveyors, when questioning owners' superintendents, could also try to bring home to them, in a general way, the prime importance of adequate ballasting to secure reasonable propeller immersion. This is specially important on winter North Atlantic west-bound voyages where 18 to 20 ft. leaving draughts aft should be aimed at. The fitting of a main engine tachometer would also be very worthwhile, as it would be a great boon to the engineers when endeavouring to control racing and avoid running on torsional critical speeds. I do not know whether Surveyors could, in fact, influence superintendents in these directions, but at least any efforts made could only do good as regards the still heavy casualty rate for screw shafts in this class of ship.

Mr. Knowles touches upon torsional vibration, change of propellers and so on, and it should be made clear that if a change has been made in moment of inertia, it is important to report this, even if there is no existing torsional endorsement or restricted speed range. The reason is that such a change may well bring a critical speed into the running range which was previously innocuous, with unfortunate results. This is equally applicable to any substantial change in the shafting system such as flywheels, dampers, crankshaft balance weights, flexible couplings, etc.

Mr. BATTEN

Being in the fortunate position of not having to write engine reports, I am the more appreciative of the contribution Mr. Knowles has made to their elucidation, but I feel that a glossary of terms and abbreviations would have made a useful addition to the paper.

On page 4, reference is made to the Metalock process for repairing castings. I think that it is important that these be examined after repair, for if the metalocking is done across the crack there is still no guarantee that the crack will not extend in length. There should be *at least* one re-examination after a specified time.

On the subject of screw shafts, I support Mr. Archer in his remarks on fatigue damage, though I would cross swords with Mr. Siggers on the question whether cracks of slight depth may be regarded more favourably with a view to cutting them out, and I would rather say that a crack of any depth necessitating cutting out, however smooth the resulting notch, should be regarded with the greatest suspicion and should be re-examined after 12 months.

Finally, a word on propellers. I once returned from vibration measurement on a ship and had occasion to refer to the First Entry. Under the line on propeller details I found:—

Diameter Pitch Number of blades
Whether moveable Developed Area

It was very encouraging to know that there was a propeller, but so far as calculations were concerned it wasn't very helpful.

I would also like to see the weight and moment of inertia of the propeller on the First Entry. I feel that, as the source of so many vibration problems, the inclusion of such details would be of considerable benefit.

WRITTEN CONTRIBUTIONS

Mr. J. WORMALD (Cardiff)

I do not think it would be an exaggeration to say that an Outport Surveyor who reads "Some Notes on Engine Reports" and absorbs all he reads will have acquired 20 or 30 years' experience of reporting with very little effort on his own part. It is, unfortunately, true that many Surveyors look upon reporting as a necessary evil and do not apply themselves as carefully or as attentively to this part of their duties as they do to the more interesting parts, and Mr. Knowles has undoubtedly put his finger on one of the points when he says that "there are some who think our criticisms are little better than annoying pin-pricks".

Many of my contemporaries will agree that what we received in similar circumstances were rapier-like thrusts; these were meant to be felt, and they were felt, our seniors often rubbed salt in our wounds and sometimes our colleagues added to our discomfiture by their jokes or laughter, but it was all done without malice and I, for one, think that these experiences helped us to a fuller appreciation of the value of a clear and concise report. To continue a little further on these lines, Mr. Knowles refers to the importance of the "family spirit"; this also existed strongly in the days to which I have referred, but what a young Surveyor generally received when he entered the small intimate family circle of "Engine Reports" was a good deal of firm but fatherly advice which it paid to remember.

Machinery installations become more complicated, periodical surveys are rarely carried out as one operation and, as a result, reporting procedure becomes more involved. The Outport Surveyor is faced with the problem of co-ordinating a mass of information on a tabulated form; to help him in doing this there are printed instructions on the

form itself; there is a Rule Book; there are Instructions to Surveyors; there are Circular Letters, and there are Deferred Reports and, speaking as a harrassed Outport Surveyor, all these roads do not lead in the same direction. Mr. Knowles has given us the wherewithal for making what is known in contemporary language as a "Master Plan" and we ought all to be more than grateful to him for the guidance and help he has provided.

However, confusion is not always entirely the fault of the Outport Surveyor. Instructions to Surveyors, Part 3b (1957), Section 10a concludes with "The term 'General Service' should not be used . . . .", but general service pumps are referred to in more than one place in the Rules; we still receive copies of letters from Head Office, addressed to owners, in which the general service pump appears specifically as an item remaining to complete the continuous survey cycle, and it appears frequently on 7E Forms without any other reference to its general service uses. When dealing with cases such as these, to report a general service pump under an entirely different name without suitable explanations would invite comment.

The instructions regarding the use of the word "good" frequently cause doubt and misgivings in the minds of Surveyors, and it would probably be helpful if Mr. Knowles would confirm that the use of the word "good" to describe the condition of an item in a Classification report form, and considered purely from a Classification point of view, means that the item so described is considered by the Surveyor writing the report to be in fit condition to go to the next normal examination, and that no other interpretation will be put upon the word "good" by the Society? An authoritative statement on this point would undoubtedly do much to eradicate the use of words such as "satisfactory" and "efficient", which we are not supposed to use and which are presumably thought to be too indefinite.

When a motorship is undergoing Special Survey, the continuous survey cycle of the oil engines should be completed concurrently, and this often leads to mistakes and/or omissions. Surveyors will find it helpful to make their own rough copy of the latest 7E and then to make an outline diagram of the machinery installation on the reverse side—this will be found most useful for linking up the various pumps with the names given to them on the 7E and for ensuring that the survey is, in fact, complete. If, however, questions still arise when the report is dealt with in London, the information available to the Surveyor as a result of his efforts should, if he has done the job properly, make his position clear and unassailable. Mr. Knowles refers to these outline diagrams in connection with turbine driven vessels, but is there any good reason why they should not be made, as part of the First Entry Report, for every installation and a photostat copy attached to the 7E which accompanies the Deferred Reports on all motorships or steamships on the C.S. basis?

Nowadays replacement pumps frequently arrive at a repair port for installation on board ship, and it is obvious that they have not been built under survey as required by the Rules. In the majority of cases they have been manufactured by reputable firms who submit only a portion of their output to the Society's survey, and a good overall examination combined with a test under working conditions should be sufficient to satisfy the surveyor as to their condition and suitability for acceptance, but would a like procedure be acceptable to the Committee in the case of, for example, a high pressure turbo-feed pump? There is obviously a difference between such a pump and the second-hand pumps referred to in the "Instructions to Surveyors", and should they not be dealt with differently from a Classification point of view?

A good deal of controversy still arises with regard to pumps for essential services, and Superintendents and Surveyors do not always see eye to eye on this point. Individual installations require special consideration, but would Mr. Knowles agree that the unassociated lists given in G 103 and M 2403 of the Rules adequately cover the requirements when looked at from a theoretical point of view?

In the case of ships with R.M.C. certificates, it frequently happens that the sea connections are opened out whilst the ship is in dry dock, but that no other part of the refrigerating machinery installation is dealt with at the port concerned. These valves require to be examined for the S.R.M.C. record only, and not at every docking as was the requirement. I still feel that a separate Report 18 should be sent in every time the Surveyors are asked to inspect these valves, but I would be pleased to have the views of Mr. Knowles on this point.

The Society, as a whole, and the Staff at many of the outports have become so large and Classing Letters have now become too formal and stereotyped—(would I be more likely to get away with this if I said "somewhat" and not "too"?) with the result that they have almost become impersonal communications. Surveyors, in the regular absence of direct comment or criticism from Headquarters have some justification for thinking that all their reports are above reproach, but this paper should do much to dispel such thoughts. In the case of those whose response to pin-pricks is negative, dare a sympathiser with "Engine Reports" suggest an occasional guided missile, which could not be mistaken for a pin-prick, with the name of the victim clearly stated on the warhead?

It is to be hoped that the reaction of Surveyors to these very helpful notes will be that there is nothing in them that will not be beneficial to remember and that all Surveyors will bear in mind the final remark which I am deliberately, and cynically, amending to "Something will surely crop up to-morrow which will have been mentioned!".

Mr. Knowles' paper will, we are sure, be of great assistance to all outdoor Surveyors. It covers everything which may be doubtful when writing the reports, and is presented in an understanding and practical manner.

The problem, when one of two auxiliary engines breaks down, is properly solved in the paper. We would just add a few words. When one breaks down at sea, there is of course nothing to do but to run the remaining engine as carefully as possible.

Concerning the question of overhauls, Engineers should be told that overhauls should be carried out in port, but we have many times met with the reply that one of the two engines has been overhauled at sea as both are urgently required in port. In such cases, the Surveyor should draw the Chief Engineer's attention to the risk and that he himself will be held responsible if anything should happen.

Another thing which can cause difficulty is the orientation of identification numbers of cylinders or other components. Some owners and builders number from aft contrary to L.R.'s practice, and the Surveyor must be careful about accepting the ship's engineer's identification without confirming the number of each item himself. Incorrect numbering can lead to much confusion in reports and certificates.

Our thanks are due to Mr. Knowles for his valuable information notes, and we are sure that the Reports Department will have the satisfaction in noting, after some time, that incoming reports are showing the benefit therefrom.

Mr. BROOK-SMITH (Hamburg)

Mr. Knowles' informative paper has been read with interest and it is hoped with profit, throwing light as it does on unexpected comments in classing letters, especially in cases which do not appear to be wholly covered by the Rules. The opinion is formed that a Surveyor should read carefully all classing letters that come into the office, whether he is personally concerned or not, and discuss the reasons for them with his colleagues.

Referring to Mr. Knowles' remarks about First Entry Reports: Is it the approved minimum U.T.S. of a tailshaft that is required to be reported, or would it not be better to record the actual minimum U.T.S. of the shaft as shown on the forging certificate, as in the course of manufacture the shaft may be stronger than was originally called for? I feel it is a pity that the minimum Rule size of the shafting is not recorded on the First Entry Reports, as I believe the only place where it can be found is on the calculation sheets in the Plans Department.

The fact that an engine may be approved for a higher power than the straight shafting is not generally known, and some enlightenment on this would not be out of place. Would such an engine have a condition of class limiting its horse power?

In the course of survey duties, cases are met in which, what would appear to be non-essential, fresh water pumps are opened out for inspection, but are found after enquiries to be capable, and used for, transferring the fresh water to the tank from which in turn essential fresh water is drawn for the boilers or cooling system.

Mr. Knowles refers to our old friend the S.R.L. In a recent paper attention was drawn to the fact that this should not be referred to as such in the case of a Report 8; apparently it is quite in order to do so when a Report 9 is concerned, as no comment has been made on this.

It would be of interest if the Author could express an opinion as to the time factor necessary before a condition of class concerning a "Metalock" repair considered satisfactory, may be deleted. Such a repair in a cylinder should, in my opinion, never be accepted as permanent. This may be considered to be a sweeping statement, but having twice seen cylinder liners where the "Metalock" had come out, leaving a hole approximately $\frac{1}{4}$ in. diameter through to the water space, I can only say that the results in each case could have been disastrous after a short pilot stop, had not observant watch keepers noted gassing in the cooling water returns.

In the final paragraph dealing with the Report 9, the Author makes life easier by saying a number of repairs can be collected together and reported as "General overhauling effected as required". It would, however, be some help if information was given in a general way on the type of repairs to be detailed.

It would be a help if Surveyors were to include on their interim certificates the items outstanding to complete a R.M.C. Running Survey, as well as those seen. If the survey is spread over more than two ports, and one of the certificates is not available, coupled with the fact that the survey book has not been correctly kept, this can lead to difficulties. Whilst on the subject of interim certificates, attention could be drawn to the fact that the Surveyor examining the insulation of refrigerated cargo spaces should recommend the specific date to be assigned. This also applies to the port where a boiler survey is commenced.

The recommendation regarding the splitting of a Loading Port Survey seems to be contradicted where the Rules state that a survey need only be held at intervals of two months when a vessel is on voyages of less than this period. There should be no harm in splitting a Loading Port Survey, provided the Surveyor examining a space for cleanliness can see it battened down or locked up as he leaves it, and it is understood that it is to be used immediately after arrival at the next port. What should be condemned is passing for cleanliness of 'tween decks at the same time as the hold in the same hatch.

A danger as regards cleanliness of spaces is in those cases where the fans can be reversed. Dust out of sight and securely lodged in the suction trunk can, due to the reversal of the air flow, be

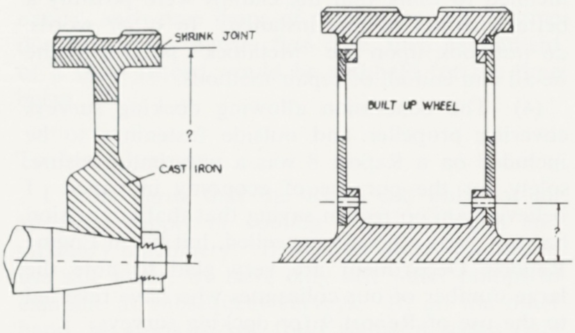
blown into the space already passed for cleanliness, with the fan at the time working in the one direction.

It would be interesting to know if Engine Reports Department has any special wording of phrases they would like to be adopted when filling in the recommendations which frequently follow a stereotyped form such as: "efficient condition", "good condition", "good order" or "satisfactory condition", etc., or whether such are necessary at all, and the recommendation could simply read: "The Machinery of this vessel is eligible, etc.".

Mr. P. F. WILLEMSE (Rotterdam)

I have read the paper "Some Notes on Engine Reports" with much interest and am obliged for the useful hints put forward.

In connection with the paper, I would like to ask the following question concerning turbine vessels: It is stated that the diameter at wheel shroud is not the diameter of the wheel, which is quite clear, but I should be pleased to learn the diameter to be reported in the cases shown in the sketch. In the right-hand sketch what is the shroud diameter if the bolts are staggered ?



Mr. PEACOCK (Liverpool)

On page 4, col. 2, paragraph 4, the Author states "Whenever a subject of class is amended or deleted, due mention should always be made in the recommendations on Reports and Interim Certificates".

It is generally thought mention should be made in the reports, but there is a difference in practice and opinion about whether reference should be made to the amendment or deletion of a subject on a fresh Interim Certificate, especially bearing in mind that Surveyors frequently do not know the up-to-date position regarding S.R.L. items when carrying out their survey.

Mr. COLLINSON (Plymouth)

I have read Mr. Knowles' paper on Engine Reports with much interest and appreciation and am sure it will prove a valuable guide to all Surveyors, including an "old warrior" like myself, for although I spent some time in the 'twenties on the Chief Surveyor's Staff and had to deal with most things from Rules and plans to reports, the Society's requirements are constantly changing and what satisfied Solomon does not always please David.

I am very glad to see the Author's reference to "the family spirit". It was very much alive in the 'twenties and Headquarters did their best to help the Outdoor Surveyors. Minor omissions and errors which had crept into a report were usually dealt with by a private letter of explanation to the Surveyor and his report was often returned to him for correction.

First Entry—General. The fourth paragraph is not quite clear—what use is the *approved* U.T.S. without the *actual* U.T.S. in the forging report in the case cited.

Auxiliary Machinery Certificates. There is a great deal of unnecessary correspondence and work in connection with these at an installation port. I find that before I can gather all the copies necessary together I have to write for at least 60 per cent of them and sometimes I do not get the certificate until after the vessel has sailed.

It is quite a simple matter for the Surveyor issuing the certificate to check where the auxiliary is going to be installed and to send a copy of the certificate to the Surveyor concerned. I always did it myself when on new construction. In fact, there is no excuse so far as items coming to this district are concerned, since I insist on the shipbuilders supplying me with two copies of all their orders, one of which is sent to the Surveyors who will be surveying the item.

Then again a first entry on a main engine arrives without any air receiver certificate or mention of it on the report, although the air receivers were supplied and probably made by the engine maker. Or, in the case of an auxiliary set, consisting of say, engine, generator, air compressor and pump—the certificate relates only to the engine, seldom are there any certificates, or mention of the driven machines and the makers' certificate for the generator is usually missing, as also is the makers' certificate for the motor when the auxiliary is electrically driven.

Electrical Rpt. 13. What is required here? The reason for the position of the generator and switchboard is surely so that it can be identified for subsequent surveys and where there is only one engine room, one generator, or one switchboard surely, "in the engine room", "adjacent to the generator" is sufficient—or in the engine room P & S, etc., as the case may be when there is more than one generator.

In conclusion, may I express my thanks to the Author for his helpful paper and if he will forgive me for paraphrasing his last paragraph:

The trouble is that, in these days of rush, something will surely crop up to-morrow which should or should not have been mentioned.

Mr. G. M. BOYD (Headquarters)

I would like to endorse what Mr. Shields has said, and to point out that these principles, and many of those mentioned in the paper, apply with equal force to the reporting of hull defects and damage.

Research, directed to the reduction of troubles in ships, is becoming an increasingly important facet of the Society's activities, and the keeping of readily accessible, fully cross-indexed records is essential to such research, not only in regard to machinery, but also to the hull structure.

While the methods and means for such recording are available, and in fully efficient operation in the Technical Records Office, its usefulness depends very largely on the co-operation of the Surveyors, and particularly of the Reports Departments in passing to T.R.O. as many reports as possible, even of relatively unimportant defects. The cumulative effect of many minor defects may call for action, and possibly amendment of Rules.

AUTHOR'S REPLY

To Mr. Siggers

I agree entirely with Mr. Siggers' remarks about damage reports and the forwarding of private opinions as to the cause of damage by separate letter to Head Office. Don't make the mistake, however, of referring to the existence of such a letter in your report ! This may sound laughable, but we actually had such a case not long ago.

I agree also with Mr. Siggers' views regarding damage surveys on the machinery of ships not classed with this Society.

When acting as builders' representative at a survey at the end of the guarantee period, our colleagues must of course be very careful to sift out which items affect classification and which do not. Owners' representatives will often try hard to extract a statement which could be construed as admitting builders' liability. This must be avoided at all costs. As I see it, our colleague's job is to report the facts in full to the builders, with his recommendations, and leave it to them to sort out any questions of responsibility.

To Mr. Shields

I appreciate the reasons for supplying the Chief Engineer Surveyor's Records Department with as much information as possible concerning defects and repairs, and hasten to say that we in the Engine Reports Department do our best to comply at all times. All too often, however, the reports give just the bare minimum of information for classification purposes, and no extra details which may be of use to the C.E.S.R. Department. It then becomes necessary for them to make their own enquiries.

To Mr. Dunn

Mr. Dunn has most kindly placed numbers against his queries and I will deal with them in that order.

(1) I agree that interim certificates covering part of an E.S. survey should contain a brief list of parts seen. Such an arrangement would act as a ready check with owners' records and be of help to our colleagues when further advancing the survey.

(2) A boiler defect which is recorded in the S.R.L. Appendix for attention at next boiler survey is not automatically to be dealt with at the *due* date of boiler survey. It is merely a note of guidance.

(3) I have said that items of importance which have been repaired by the "Metalock" process should be re-examined after a period of service. This is of course for the purpose of proving whether the repair is satisfactory, and has nothing whatsoever to do with the fact that the repair was done by this particular process. A large number of such repairs do in fact prove to be satisfactory but, on the other hand, some do not.

I have in mind a case of a cast-iron bedplate of an old diesel main engine which cracked at one of the forward corners at the base of some stiffening webs. Temporary repairs were made consisting of very substantial clamps holding the whole of the affected part together, and so far as I know, all went well. At a later date, the clamps were removed and "Metalock" repairs were carried out, but before long these worked loose.

You could well argue that the "Metalock" repair had not been properly done, but I am inclined to think that the clamps were possibly a better method in this instance. In other words, do not look upon the "Metalock" process as the be-all and end-all of repair methods.

(4) The concession allowing docking surveys covering propeller and outside fastenings to be included on a Report 8 was a war-time measure, solely for the purpose of economy in paper. I believe I am correct in saying that that concession has not been officially cancelled, but we in Engine Reports Department are very glad to note the large number of our colleagues who have reverted to the use of Report 9 for docking surveys.

I think without doubt that a separate Report 9 should be made when a vessel is examined afloat after grounding.

(5) When recommending a screw shaft to be re-examined after a further 12 months' service, it is the custom to withhold a fresh record of survey. This is because a 12 month limit on a "three-year" shaft (i.e. "C.L." or "O.G.") is looked upon as a "short" limit. If the re-examination can be done without completely drawing in the shaft and proves to be satisfactory, the survey record which was withheld may then be assigned even if a further re-examination is called for.

(6) I think Mr. Dunn is really referring to the *testing* of a gas condenser or evaporator, in which case it would be correct to say that this is not required until eight years old. Bear in mind however that, if the condenser happens to be of "shell and tube" type, it must be *examined* every two years in way of tube plates and tube ends.

(7) A Report 18 is not solely for the purpose of reporting a stand-by water circulating pump which is being examined for C.S. purposes. A note should, however, be made on the Report 9 drawing attention to its availability for R.M.C. purposes and requesting that it be noted accordingly.

(8) I presume Mr. Dunn is referring to cases of "Cleanliness" surveys held in one country, but refrigerated cargo will not be loaded until arrival in another country. In such cases, I fully agree that the certificate should make it quite clear that a *full* Loading Port Survey must be held at the loading port.

(9) The Rules state that the date of S.R.M.C. record must be the same as the R.S. date. If the last R.S. date is many months ago, then the S.R.M.C. record will be back-dated accordingly. It is in cases of this nature that it will probably pay the owner to carry out a further R.S. concurrently with the S.R.M.C. and thus obtain up-to-date survey records.

(10) Where a vessel's R.S. record has expired or is about to expire, I am quite certain that we have no right to refuse assignment of a fresh R.S. record just because an item of machinery will become due for survey again in a few months' time. We in Engine Reports Department take care of such cases by informing the owner accordingly, and I am glad to say that we do not experience any great difficulty in this respect.

I should, perhaps, add that, where the present R.S. record still has several months to go before expiry, and some items of machinery will become due for survey before that date, then assignment of a fresh record would be withheld for the time being.

TO MR. GUTHRIE

I quite agree that the Rules call only for an adequate supply of cooling water for main and auxiliary machinery. If then an owner decides to use salt water, we have only salt water pumps to examine at subsequent surveys. If, on the other hand, he elects to use fresh water, it seems only logical that the fresh water pumps and fresh water coolers should be considered as part of essential equipment.

Mr. Guthrie's remarks regarding cooling water pumps for R.M.C. purposes are correct on paper. There are, however, not a great number of vessels with only one such pump and we usually find that stand-by connections are arranged to two or three other pumps, thus cancelling out any apparent hardship on the owners.

With regard to the question of expiry of an R.S. record before completion of the voyage and the matter of a "period of grace", I would say that the period of 12 months between running surveys is considered to be the maximum which can reasonably be given, and no period of grace is contemplated. This view was held at the time the present Rules were drafted and its wisdom has been amply demonstrated, particularly in regard to "shell and tube" type condensers, numbers of which have developed defects in a short space of time.

Mr. Guthrie asks why I have devoted so much space to explain R.M.C. surveys. The plain answer is that the errors and omissions on reports have warranted it. I think it is true to say that some of our colleagues would prefer to crawl through some filthy boilers rather than to carry out a R.M.C. survey, and I can only assume this is because their knowledge of R.M.C. work is somewhat shaky, or perhaps they are not very interested.

I think we ought to remember that the R.M.C. class came into being many years ago as the result of losses suffered by owners, underwriters and shippers due to the frequency with which cargoes arrived at their destination in bad condition. Again, the main engine might break down at sea necessitating towage to port but, if the R.M.C. plant can be kept running, the cargo can possibly be saved and its value may well exceed that of the vessel. I think then it is up to us all to take as much care with our R.M.C. work as with other kinds of surveys.

I believe Mr. Guthrie's final question about assignment of a S.R.M.C. record has been dealt with in the penultimate paragraph of my notes on Report 18.

TO MR. ARCHER

I must thank Mr. Archer for drawing attention to an error under the heading of "First Entry—General". The words "minimum approved U.T.S." in the fourth paragraph should read "minimum actual U.T.S."

I am very interested also in his remarks regarding "fatigue damage" to screw shafts. Surely this emphasizes the prudence of re-examination after a further period of service.

TO MR. WORMALD

I am in entire agreement with Mr. Wormald's remarks regarding "General Service Pumps". This term has been in constant use all over the world for many a year and its meaning is well understood by the shipping fraternity as a whole. To ban its use would, in my opinion, achieve no useful purpose.

When describing the condition of machinery items as "good", the understanding is that the item is considered to be in a sound and efficient condition until the next regular survey becomes due. Thus, boiler mountings will be considered "good" until the next B.S. is due. Again, a diesel generator engine or a pump will be considered "good" until four years hence in the case of a vessel which uses the continuous survey system, or the next E.S. where this system applies.

I appreciate Mr. Wormald's remarks about sending in a simple or diagrammatic arrangement plan of the contents of an engine room with the first entry report. My words are perhaps not fully clear but were intended to refer to all types of machinery, and not solely to turbine-driven vessels.

With regard to acceptance of replacement pumps on a ship, I think that each case must be judged on its merits. An ordinary new reciprocating pump for low-pressure duties such as bilge service could well be accepted after a general examination and a test under working conditions, but care should be taken to ascertain that its capacity is not less than the pump it replaces.

A turbo-feed pump is, of course, rather a different proposition. If it is new, it should not be difficult to obtain documentary evidence from the makers as to the designed steam pressure for the turbine and the hydraulic test pressures which have been applied to the pump and turbine casings and valve chests, also the capacity of the pump. If these particulars are obtained and found to be satisfactory, I would accept the set after satisfactory running tests.

In no case, however, should a second-hand pump for any essential service be accepted until it has been opened out and examined and, in the case of high-pressure items, suitable hydraulic tests should be carried out.

I find it difficult to understand why there should be differences of opinion between Superintendents and Surveyors as to which are the essential pumps in a ship. The word "essential" refers, of course, to any item which is necessary for the propulsion and safety of the ship, also to the R.M.C. plant, and does not refer to pumps solely on domestic services.

I do not consider it necessary to issue a Report 18 when the only item involved is the sea connections, provided a suitable note is made on Report 9 calling attention to the R.M.C. parts. (See also my reply to Mr. Dunn.)

To Mr. Brooke-Smith

Mr. Brooke-Smith is quite right regarding "minimum U.T.S." on first entry reports and I have cleared up the point in my reply to Mr. Archer.

Difference between the approved power of an engine and its straight shafting often occurs. The engine builder submits a crankshaft plan for a certain engine without mentioning its destination and it is approved for certain conditions. Eventually the shipbuilder submits a plan of straight shafting with certain particulars and states that he proposes to use the above-mentioned engine. If the power required for the straight shafting is less than was approved for the engine, the latter will be suitably derated by its makers. No condition of class would be imposed since it will be on record that the straight shafting was only approved for a certain horsepower, and this is now stated on the classification certificate.

Engine Reports Department are very firmly of the opinion that the imposition, amendment or deletion of conditions of class should be clearly stated in the recommendations at foot of the report concerned and on the interim certificates.

It is not easy to make any hard and fast statement as to how long a "Metalock" repair should remain as a condition of class. The position of the repair and the stresses likely to occur in service will have some bearing on the matter, and this is referred to in Instructions to Surveyors, Part 3b, paragraph 5j. When making a re-examination of such repairs, one should always ask the chief engineer or owners' representative for the history of the case. This may be very helpful in deciding whether to recommend deletion of the item as a condition of class and entry of same in the S.R.L. Appendix.

My remarks about "General overhauling effected as required" are, I think, clear when read in the full context. Lifting of crankshaft and realignment of shafting, boring out of cylinders of the main engine, renewal of cylinder covers and liners, part renewal of combustion chambers, renewal of boiler tubes, and so on are some of the points which spring to mind as needing particular mention on reports.

Mr. Brooke-Smith's comment about splitting a loading port survey is not quite correct as this does not occur in vessels on short voyages such as the North Sea and Mediterranean services, where the vessels often have only one or two refrigerated cargo chambers.

In his final paragraph, Mr Brooke-Smith refers to various phrases in common use and I don't doubt but that all sorts of interpretations could be placed against them if one wished to do so. I think the following time-honoured phrasing takes some beating: "The machinery of this vessel, as now seen, is in good condition and eligible to remain as classed without fresh record of survey" or ". . . . eligible for fresh record of . . . .".

To Mr. P. F. Willemse

To Mr. Willemse's question, I would state that the "diameter at wheel shroud" refers to the shaft diameter at this position, and has no relationship to the design of wheel shroud.

To Mr. Peacock

Mr. Peacock comments on my remarks that "whenever a subject of class is amended or deleted, due mention should always be made in the recommendations on reports and interim certificates" and seems to think that this may cause a measure of misunderstanding because the Surveyor may not know the up-to-date position regarding all such items.

In reply, I assume that the item now repaired or renewed is already known to be a condition of class. It is therefore necessary to state in the general recommendations to the Committee whether you consider an amendment regarding this item to be necessary, or whether you recommend the item be deleted, and not to rely solely on statements in the body of the report.

Since your recommendations should always be identical on report and interim certificate, it follows that the same wording should appear on the certificate concerning the subject item. (See Instructions to Surveyors, Part 3b, paragraph 5b.)

In addition, I cannot help but feel that such action will often prove to be of great benefit to our colleagues at the next port of survey.

To Mr. Collinson

I appreciate the difficulties which occur in assembling certificates for various items which have been made elsewhere. If it is known at the place of manufacture that the item is destined for a particular vessel, then there is no excuse for

failure to send a copy of the certificate immediately to the Surveyor concerned. On the other hand, machinery is often built for stock and, when finally allocated to a particular ship, the builders have forgotten that the local Surveyor is still interested in the matter.

The system whereby the shipbuilders furnish the Surveyor with duplicate copies of their orders for essential items is, of course, praiseworthy. It is, however, something which is not likely to be achieved unless the Surveyor makes himself well-known to the higher officials at the shipyard and convinces them of the advantages to be gained and of his desire to help the job along.

With regard to the Electrical Report 13, I presume Mr. Collinson is referring more especially to yachts, since the percentage of other types of vessel with only one generator set is very small to-day and these will not require electric power for essential services. It will, of course, be remembered that, if electric power for essential services is needed, the Rules require a spare generator set to be fitted.

To Mr. Batten

With regard to particulars of propellers being available, I would remark that up-to-date certificates of manufacture and testing of propellers have a space for recording the weight and moment of inertia. The latter is also provided for on the up-to-date first entry report form.

Finally, I would like to express my very sincere thanks for the kindly and appreciative remarks which have been made about these notes. These remarks, coupled with the lively verbal and written contributions, have made the job well worth while.

Printed by Lloyd's Register of Shipping
at Garrett House
Manor Royal, Crawley, Sussex, England

Lloyd's Register Staff Association

Session 1958-59

Paper No. 6

SOME EARLY TECHNICAL RECORDS OF THE SHIP DEPARTMENT

by

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71, Fenchurch Street, LONDON, E.C.3

The Author of this paper retains the right of subsequent publication, subject to the sanction of the Committee of Lloyd's Register of Shipping. Any opinions expressed and statements made in this paper and in the subsequent discussion are those of the individuals.

Some Early Technical Records of the Ship Department

By C. V. Manley

It is commonly understood that the idea of a Ship Surveyor, in the sense in which we use the term, originated when Lloyd's Register of Shipping was founded in 1760. The earliest Ship Department record shows that this was not so. It is an extract from some Observations and Notes concerning Sea Service written by Sir Walter Raleigh, *circa* 1600, and it reads:—

"For the strong and true building of a ship is not to be left barely to the fidelity of a marchanticall artificer (the chief end of whose work in his owne accompte is his profit and gaine) but some superior officer ought to have a further regard in that business; if he be such a one as hath more judgement in the building and conditioning of a ship than devotion to his own case and profit."

Note the word "superior".

In 1834, the Headquarters Staff of Lloyd's Register of Shipping at White Lion Court consisted of the Secretary, two clerks and three Surveyors. As the Society's affairs prospered and began to expand, the number of clerical and technical officers at Headquarters was suitably augmented, and by the 1880's had grown to 23 clerks and 17 Surveyors.

The Ship Department, as an administrative department, may be said to have commenced in 1887, when Mr. F. D. Harwood was appointed as a junior clerk and attached to the Chief Surveyor, Mr. Martell, to carry out the clerical duties, keep the technical records, and later to prepare official letters for the Secretary on technical matters dealt with by Mr. Martell and his assistants.

Although this was only 72 years ago, and almost within living memory, it is difficult to picture the situation which existed then.

Hansom cabs rattled about the streets, accompanied by a few horse buses and horse-driven trams, and the only other means of travel (apart from Shanks's Pony) was by rail. The telephone was in its infancy. There were no motor cars, no underground railways, no electric light. The merchant fleet consisted mainly of wood, composite and iron ships, and sailing ships were still competing with steamers.

The first Rules for Steel Ships had not yet been issued, the Technical Committee had not been formed, and the first Merchant Shipping Act governing assignment of freeboards lay silently veiled in the womb of time.

In 1887 the total H.Q. technical staff (including London Outport) consisted of Mr. Benjamin Martell, the Chief Surveyor, and two assistants; the Chief Engineer Surveyor and one assistant; ten Ship Surveyors and two Engineer Surveyors. The number of exclusive Surveyors at Outports in the U.K. was 80. At ports abroad representation was almost entirely by non-exclusive Surveyors stationed at European ports, in North and South America, India, China and Japan, Australia and New Zealand.

Mr. Bernard Waymouth was Secretary, and his staff included three rising young men named Andrew Scott, who became Chief Clerk and afterwards Secretary in 1904; C. F. Redman and F. A. Mayne, who were later appointed assistants to the Secretary.

Since Martell, who was Chief Surveyor (1872-1900), there have been seven Chief Ship Surveyors, Cornish (1900-09), Thearle (1909-13), Abell (1914-28), Montgomerie (1928-44), Shepheard (1944-52), Hodgson (1952-57), and the present Chief Ship Surveyor, Mr. J. M. Murray.

The first Chief Engineer Surveyor was Parker (1880-90), succeeded by Milton (1890-1921), Ruck-Keene (1921-32), Dorey (1933-56), and Mr. H. N. Pemberton.

The Author, in his early days, knew Mr. Cornish, and in course of service since the outbreak of World War I has had personal association with all his successors except Dr. Thearle, who died towards the end of 1913.

Mr. Cornish was one of the most charming products of the Victorian age. He was an accomplished artist, a member of the Savage Club, and a real *bon-viveur*. A series of pictorial drawings made by him in the 1860's to illustrate the Rules for Composite Ships were exhibited and gained awards at exhibitions in Paris and Moscow. They were lent by the Committee to various Exhibitions and Institutions on numerous occasions, and remained in our possession until 1940. Unfortunately, they disappeared during the war. His *magnum opus* was the 1909 revision of the Steel Ship Rules, following upon the 1906 revised Freeboard Regulations. He lived to a ripe old age, and for many years after his retirement he paid an annual visit to 71, Fenchurch Street to present Christmas cards, beautifully drawn by his own hand, to senior officers of the staff.

An example of the artistic handwriting of the Victorian days is given in the reproduction of part of an endorsement written in 1895, initialled by Mr. Martell, Dr. Milton, Mr. Cornish and Dr. Thearle. (Fig. 1.)

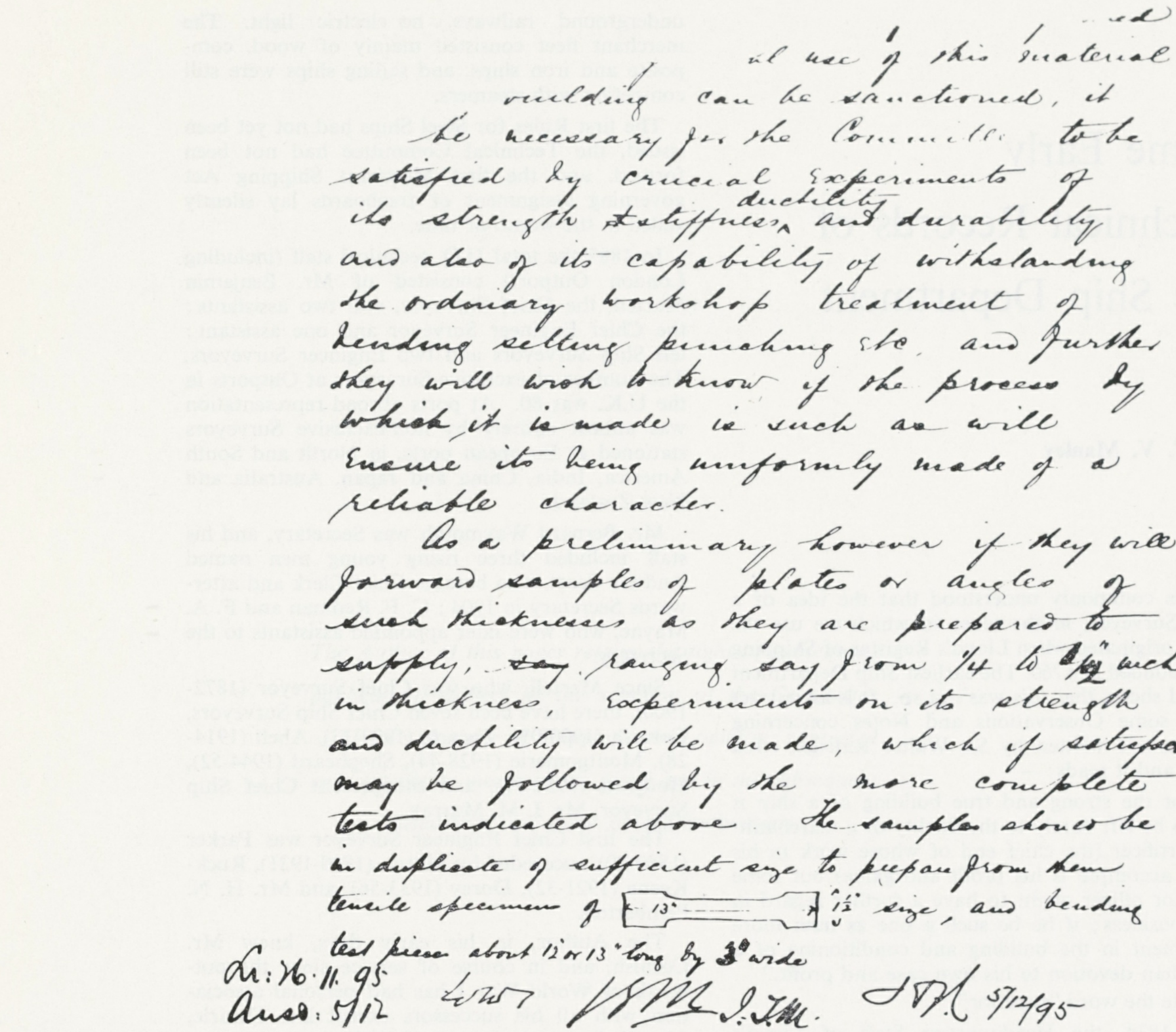


FIG. 1.—REPRODUCTION OF PART OF AN ENDORSEMENT WRITTEN IN 1895

In the early days there was no compulsory limit for retirement; those who kept their health and strength stayed on and often died in harness, and there were some unusual cases of long service. When my late colleague, Mr. R. J. Sladden, was excavating the early history for preparation of the Annals he found record of one John Inville who had been appointed a junior clerk to the original Register in 1765 and served for 68 years until 1833. Henry Adams, who later became Chief clerk, served from 1815 until his death in 1887. Sir Andrew Scott's service of 65 years included 18 years with Henry Adams. This constitutes a remarkable living link; if these gentlemen had talked to each other of their early experiences, it made possible a first-hand account in 1940 of what happened in the Society in 1765.

Sir Westcott Abell and Dr. Milton were two of the most versatile men one could ever meet—both had a wide interest in and knowledge of every conceivable subject, both inside and outside their profession. These eminent men successfully steered the Society's technical policy through a difficult period, including all the far-reaching developments which resulted from the outbreak of World War I. The achievements of their successors are within more recent memory, and are well known.

Early in this century the Chief Ship Surveyor's Staff consisted of G. Stanbury and Dr. S. J. P. Thearle, assistants; and C. Buchanan, C. Fowling, G. R. Mares and C. H. Jordan, Principal Surveyors. There was a Plan Approving Staff of four, namely:—

Dr. Bruhn (who afterwards left to become Chief Surveyor of the Norske Veritas).

J. W. Isherwood (who later left to become Sir Joseph Isherwood and patentee of the famous longitudinal system of construction).

Dr. J. Montgomerie.

C. C. Gearing.

The Freeboard Section consisted of G. R. Mares and J. W. Grier, and in the Reports section under C. H. Jordan were T. S. Warren and R. B. Watt.

All the Plans and Freeboard Surveyors, together with F. D. Harwood and staff were situated in the room on the first floor of No. 71, Fenchurch Street now occupied by Mr. W. J. Ferguson and, according to accounts, had very little room to spread out plans, etc.

In 1911 the Plan Approving Section moved to the third floor of No. 71, then newly constructed, where they remained for 40 years.

1914/15

The staff continued to increase, and at the beginning of 1915, when the Author was attached to Harwood as a junior clerk, the Chief Ship Surveyor's Staff consisted of C. Fowling and E. C. Champness, assistants; G. R. Mares and T. S. Warren, principals; and the following:—

Plans Section:—

Dr. J. Montgomerie (afterwards Chief Ship Surveyor).

C. C. Gearing.

H. Jasper Cox (afterwards Principal Surveyor for the Far East).

W. Thomson (afterwards Principal Surveyor for Research).

N. G. Turnbull (afterwards Principal Surveyor for Italy).

R. J. L. Ward (later Principal Surveyor on Chief Ship Surveyor's Staff).

H. J. Thomson.

W. Bennett (afterwards Principal Surveyor for U.S.A.).

E. Potts (afterwards Principal Surveyor on Chief Ship Surveyor's Staff).

Dr. G. Webster (afterwards Principal Surveyor for Scotland).

R. Dunsmuir.

Freeboard and Reports Sections:—

A. Chisholm (afterwards Principal Surveyor for Germany) was attached to G. R. Mares on Freeboard, and W. H. Watson and A. Pickworth (afterwards Principal Surveyor for Sunderland) worked with T. S. Warren on Reports.

The Chief Engineer Surveyor's Staff at that time consisted of H. Ruck-Keene (assistant), E. M. Salmon, J. W. Dimmock and E. J. Stoddart (Reports), and A. Lawrance (Plans).

Harwood's staff consisted of A. J. Barwick (who later became Secretary), H. E. Nettleton, D. G. Dollery and C. V. Manley.

When war broke out most of the clerks of military age and some Surveyors joined the Forces, and the staff suddenly became too small. Some lady clerks were employed—three in the Ship Department—but their services were discontinued after the war and no more were appointed until 1939.

There was a war-time revival of wood shipbuilding, and the Author has a vivid recollection of the flood of plans for these being dealt with by a succession of Surveyors, first by H. Jasper Cox, then by W. Bennett, Dr. Laws, and finally by Ernest Potts, amid much learned talk of futtocks, cant-timbers, spirketting, and other abstruse terms, which one got the impression they themselves hardly understood.

1919/20

By 1919 several of the above Surveyors had been transferred elsewhere, some newly appointed juniors added, and during 1919-20 the Chief Ship Surveyor's Staff was: C. Fowling, assistant (resident in London); Dr. J. Montgomerie, assistant (resident in Glasgow); B. J. Ives (Principal Surveyor for the Continent); F. R. Noton, G. R. Mares and T. S. Warren (Principal Surveyors); together with the following, many of whom will be remembered as having subsequently risen to high positions in the Society:—

Plans	Reports
C. C. Gearing	W. H. Watson
Dr. B. C. Laws	W. A. Grier
W. Thomson	A. E. Stevenson
N. G. Turnbull	W. Malcolm
C. A. Millar	A. W. Jackson
K. Inglis	**Research and Special Duties**
W. J. Craig	Dr. G. Webster
R. Fairley	C. Bartlett
P. Eide	A. G. Akester
S. Townshend	R. S. Johnson
Freeboard	J. S. Ormiston
W. Watt	C. H. Stocks
E. W. Blocksidge	J. Turner Morris (Concrete Ships)

There was much more of a family atmosphere among the smaller staff which existed in those days; the photographs of a friendly sporting event will be of interest.

Football Match at Dulwich, October, 1919

Surveyors: A. W. Jackson, J. Turner Morris, W. M. Balfour, C. H. Stocks, A. E. Stevenson, W. Malcolm, H. A. Garnett, C. Bartlett, R. S Johnson

Clerks: T. Stephenson, T. A. Powell, R. P. L. Roberts, C. V. Manley, A. E. Sawyer, E. C. W. Constable, K. L. Kennedy, H. W. Martin, R. J. Sladden, G. R. F. Strachan, M. S. Shapcott

Fig. 2.

The following is an extract from a letter received from the non-exclusive Surveyor at Valparaiso on the occasion of the retirement of Mr. H. J. Cornish and Mr. J. E. Stoddart in 1909:—

"Although having only made a slight acquaintance with these gentlemen, my visits to the Old Country being few and far between, nevertheless there seems to be a real link of family connection amongst all the staff of the Register, and therefore I am glad of the opportunity of showing that I belong to such a family, although only as an adopted son. I hope that these gentlemen will long continue to sail in a fit and seaworthy condition, classed **100A1**, until their arrival at the final haven of rest for which we are all heading."

Mr. Fowling, an imposing bearded figure, was forthright, determined, and brooked no deviation, however slight, from the stern path of duty. Mr. Champness was less assertive but with all the experience accumulated in a lifetime of outport surveying.

Mr. Ives, who had great continental experience, left the Society during World War I to take up a post as manager of a shipyard in Dublin, but was recalled after the war as Principal Surveyor for the Continent, and spent much time travelling Europe to re-establish the surveying duties of the different ports. Later he was appointed as assistant to the Chief Ship Surveyor.

Mr. G. R. Mares was unique in that, as a junior Surveyor 30 years previously, he had worked with Mr. Martell on the preparation of the early freeboard tables, which formed the basis of the whole structure on which subsequent freeboard legislation has been built, and he had remained exclusively engaged on freeboard duties ever since. He was of small stature with a diffident manner, which concealed a profound knowledge of freeboard matters. He was always worried about his health, and one has a vivid memory of him walking about the office in an overcoat on occasions when the weather was quite mild, complaining of the cold. He retired in 1921 and, as often happens in such cases, lived to a ripe old age.

He was assisted in the Freeboard section by Mr. William Watt. Mr. Watt was the antithesis of Mr. Mares; he had no diffidence in expressing his views in the most downright way, and no opinion which he had formed could be shaken by any argument. He was devoted to duty and always willing to work on Saturdays and Sundays when necessary, but it was characteristic of him that, as a good Scotsman, he refused to work on New Year's Day.

Mr. Thomas Warren, who was in charge of the Ship Reports section for so many years, was a stern Victorian of the old school. Heavily built and awe-inspiring in appearance, he struck terror into the hearts of any junior colleague who had to approach him. Beneath this forbidding exterior, as in so many cases, there was a fund of human kindness. Mr. W. H. Watson (Willie Watson), who assisted him, was of a different type, jovial and approachable.

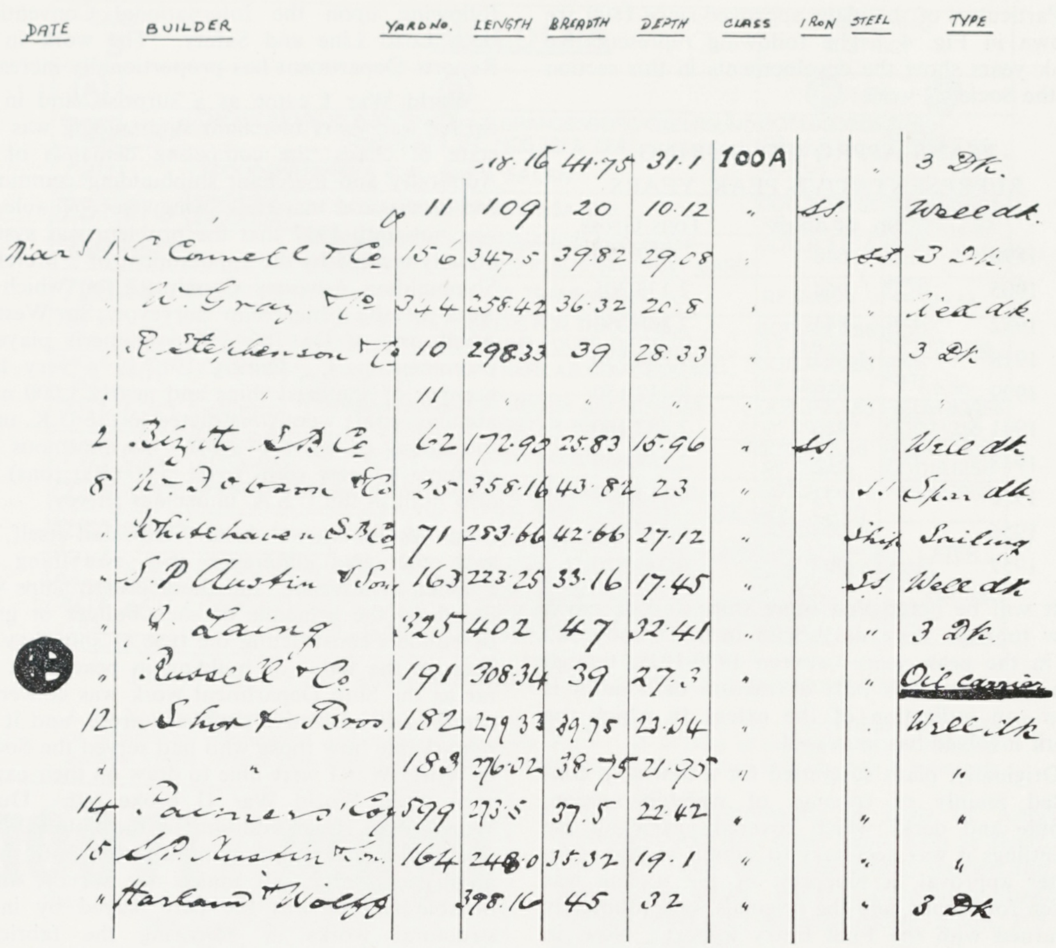
Mr. F. D. Harwood, as previously stated, built up the Administrative section of the Ship Department throughout 50 years of devoted work. He was the permanent official during the constant and inevitable changes of technical staff, and as such played an essential part. Careful and thorough in everything he did, he left behind him a remarkable example of tradition of service. Occasionally he would talk about his early days and give some fascinating reminiscences.

Discipline was very strong in those days. The principal officers were at their desks at an early hour in the morning and late in the evening, and the other members of the staff were expected to follow suit. Harwood used to tell how, on one occasion, soon after he joined, some members were thought to be lacking in this respect; they were not arriving late (that would never have been tolerated in those days) but were only just scraping in on time. One morning, when they arrived, they found the Secretary, Mr. Bernard Waymouth, a stern forbidding figure, standing at the entrance of White Lion Court; he said no word, just silently watched them all in, seniors and juniors alike. Thereafter every member of the staff kept good time.

Anyone who wishes to appreciate this story can do so by glancing at the portrait of Mr. Waymouth, now hanging on the wall behind the Clerk to the Classification Committee on the ground floor of No. 71.

Plans of New Ships

The records of new ships for which plans were approved were commenced in 1887, but only as regards numbers of ships; the tonnages were not entered until 1890, and complete records have been continuously maintained since that year. The extract from the first list in 1887 (Fig. 3) shows that some well-known builders of today were also in existence then. Note also the entry of an oil tanker—one of the earliest to be dealt with. The plans approved were for wood, iron and steel ships, both sailing vessels and steamships, and ranged from 40 ft. (yachts) to 400 ft. in length, one ship being 439 ft. The majority lay in the 200 ft. – 300 ft. range. In 1890, the figures included 114 oceangoing cargo-carrying sailing ships between 1,000 and 2,500 tons gross; there were 18 ships (steamers) over 400 ft. long, the largest being a 484 ft. steamer of 7,650 tons gross.



DATE	BUILDER	YARD NO.	LENGTH	BREADTH	DEPTH	CLASS	IRON	STEEL	TYPE
			18.16	44.75	31.1	100A		"	3 Dk.
		11	109	20	10.12	"	S.S.		Well dk.
Mar 1	C. Connell & Co	156	347.5	39.82	29.08	"		S.S.	3 Dk.
	W. Gray & Co	344	258.42	36.32	20.8	"		"	Well dk.
	R. Stephenson & Co	10	298.33	39	28.33	"		"	3 Dk.
"		11	"	"	"	"		"	"
2	Blyth S.B. Co	62	172.92	25.83	16.96	"	S.S.		Well dk.
8	W. Dobson & Co	25	358.16	43.82	23	"		S.S.	Spar dk.
	Whitehaven S.B. Co	71	283.66	42.66	27.12	"		Ship	Sailing
"	S.P. Austin & Son	163	223.25	33.16	17.45	"		S.S.	Well dk.
"	J. Laing	325	402	47	32.41	"		"	3 Dk.
"	Russell & Co	191	308.34	39	27.3	"		"	Oil carrier
12	Short & Bros	182	279.33	39.75	23.04	"		"	Well dk
"	"	183	276.02	38.75	21.95	"			"
14	Palmers' Co	599	273.5	37.5	22.42	"		"	"
15	S.P. Austin & Son	164	248.0	35.32	19.1	"		"	"
"	Harland & Wolff		398.16	45	32	"		"	3 Dk

Fig. 3.—Extract from the First Record of Plans Approved for New Tonnage, 1887

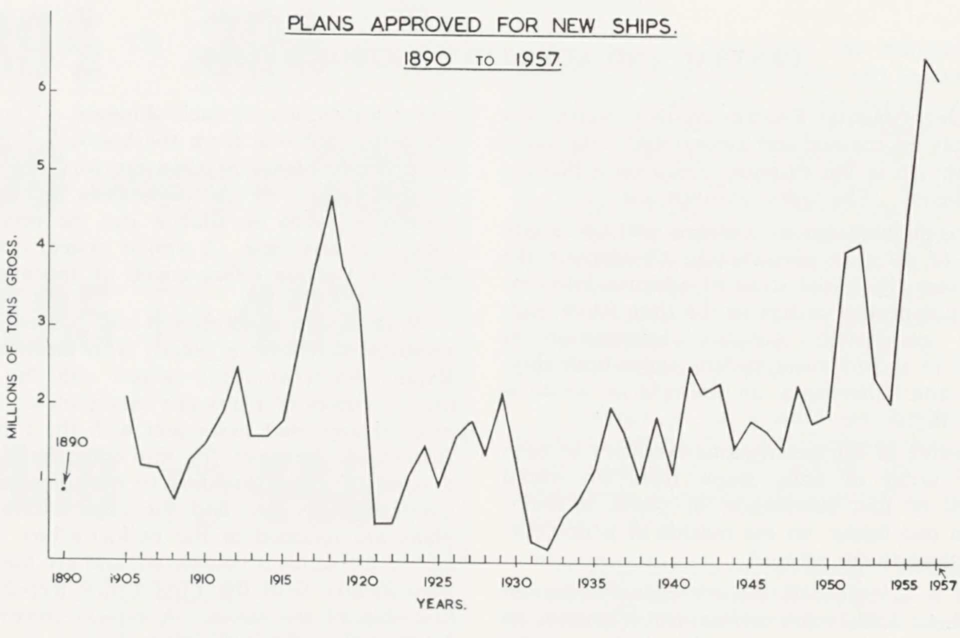


Fig. 4

Particulars of the plans approved since 1890 are shown in Fig. 4. The following representative peak years show the developments in this section of the Society's work: —

PLANS APPROVED DURING REPRESENTATIVE PEAK YEARS

	No. of Ships	Tons Gross
1890	648	902,550
1905	964	2,133,305
1912	844	2,508,050
1918	1,662	4,730,550
1929	650	2,112,150
1941	926	2,482,160
1948	515	2,289,050
1952	773	4,115,270
1956	1,038	6,467,800
1957	907	6,241,810

It will be noted that more ships and as much new tonnage were dealt with in 1905 and 1912 as in the peak years between 1920-1948, though the staff then was only a fraction of what it is now—an indication of the extent to which the work involved has increased.

Originally, plans submitted for a new ship consisted mainly of tracings of midship section, profile and decks which covered nearly all the scantlings it was necessary to submit at that time. After approval, a blueprint of the tracing was taken for record, and the originals were ultimately returned with the First Entry Report. Now, in many cases, between 50 and 100 plans are submitted for a single ship. Modern developments have necessitated the full-time occupation of a large specialised staff on research and rules. The freeboard work has increased out of all knowledge following upon the International Conventions, both Load Line and Safety. The work in the Reports Department has proportionally increased.

World War I came as a surprise, and in the earlier war years merchant shipbuilding was in a state of chaos, the competing demands of the Admiralty and merchant shipbuilding community for berths and materials being irreconcilable. It was not until 1917 that the problem was systematically tackled by the appointment of a Merchant Shipbuilding Advisory Committee, on which the work of the Chief Ship Surveyor, Sir Westcott Abell, and of Dr. James Montgomerie played a prominent part. During 1917-19 a very large number of standard ships and nearly 1,000 naval auxiliary craft were constructed in the U.K. under the survey of our Surveyors. An enormous programme of new ships (over 5,000,000 tons) was also built in the U.S.A. under our survey.

In World War II history repeated itself, but with the vital difference that everything was planned in advance, and the standard ships were based on the principle of each builder or group of builders constructing the type of ship they had been in the habit of building in peacetime. So far as the Ship Department work was concerned, similar administrative problems arose, and it was remarkable how those who had served the Society in World War I were able to draw on their experience when World War II broke out. During World War II, in addition to the colossal merchant shipbuilding programme, over 2,300 naval auxiliaries were built under our survey, and a notable feature was the part played by inland structural works in preparing the fabricated material. Except for the famous 60 ocean ships, the U.S.A. shipbuilding programme during World War II was not surveyed by Lloyd's Register of Shipping, but a large programme in Canada was dealt with by our Staff.

CENTRAL AND AUXILIARY RECORD SYSTEMS

The Departmental Records System, which was completely overhauled and modernised some years ago, is simple in the extreme, based on a lifetime of experience. The tasks involved are: —

(1) The maintenance of complete and up-to-date records of all new construction throughout the world, from the initial stage of advance information of prospective orders to the time when each ship is completed. Advance information is recorded in a card index system under both shipbuilders and shipowners, an example of which is given in Fig. 5

The whole of the constructional history of each ship, or series of sister ships, from the initial approach or first submission of plans, is maintained in one folder, on the outside of which current particulars are entered.

There is a large box file for each builder, in which these folders are permanently housed, so that each box contains a complete history of the new construction at each shipyard. The folders are never removed from the builder's box; when the correspondence is taken out for current use, a careful record of its destination in the office system is made so that it can be immediately located at any time. A similar system is followed with the London Office copies of approved plans.

When a ship is completed and classed, the correspondence folder is placed with the First Entry Report for permanent record and the departmental copies of plans are amalgamated with the original approved plans sent with the First Entry Report. If, however, the ship completed is one of a series of sisters building to the same plans, the correspondence file and the copies of approved plans are retained in the builder's box until the last of the series is completed, and are then placed permanently with the First Entry Report of the first ship of the series. A typical constructional folder is pictured in Fig. 6.

CARD 3	BUILDERS	SURVEYING DISTRICT	
(A)	(B)	(C)	(D)
725	460' (10500GR) ORE SS FOR TRAFIK A.B. GRANGESBORG-OXELOSUND (DUPLICATE OF NOS. 721 & 724)	GOT. LR 20.7.55 RF 14.9.55	GOT 25.7.55
726	(34000DW) TANKER FOR SVEN SALEN	GOT. LR 20.7.55	
731	670' (39600 DW 24000 GR) TURBO TANKER FOR SVEN SALEN	GOT. LR 20.7.55 RF 21.8.56	PRELIM 19.6.56 GOT 17.12.56
~~748~~	560' ~~M COMBINED OIL/ORE CARRIER FOR OLOF WALLENIUS~~ INCREASED IN SIZE-SEE NEXT CARD	GOT. LR 3.1.56	GOT 11.4.56
728	530' (12300GR) M.TKR. FOR REDERI A/B TRANSMARIN	RF 21.8.56	GOT 12.1.56
735 & 738	630' (25000GR) M.COMBINED ORE/TANKERS FOR TRAFIK AB. GRANGESBORG-OXELOSUND (DUPS. OF 743/4)	GOT. LR 2.2.56 RF 21.8.56	GOT 22.10.56
740 & 742	461' (10800 GR) M. ORE CARRIERS FOR TRAFIK AB. GRANGESBORG-OXELOSUND	GOT. LR 2.2.56 RF 21.8.56	GOT 1.6.56
751	670' (24800GR) TURB ~~ORE CARRIER~~ TANKER FOR REDERI A/B BIFROST (SISTER TO No. 731)	GOT. LR 21.3.56 RF 29.3.57	PRELIM 20.9.56 GOT 17.12.56
727	652' (34000DW 21700GR) M. TANKER FOR SVEN SALEN A/B	GOT. LR 1.5.56 RF 21.8.56	PRELIM 17.8.56 GOT 19.12.56
~~739~~	~~430' (4950GR) CARGO MS FOR RED. A/B TRANSATLANTIC~~ NOW ORE CARRIER - SEE NEXT CARD	GOT. LR 16.6.56	PRELIM 29.11.56
~~753~~	~~560' TURB TANKER FOR OLOF WALLENIUS~~ INCREASED IN SIZE — SEE LATER	GOT. LR 16.6.56	
743 & ~~744~~ SEE BELOW	630' (25000GR) M. ORE/OIL FOR TRAFIK A.B. GRANGESBORG-OXELOSUND (DUPLICATES OF 735 & 738)	GOT. LR 20.9.56 RF 20.2.57	GOT 22.10.56
750 & 756	461' (10800GR) ORE/OIL MS FOR TRAFIK A.B. GRANGESBORG-OXELOSUND (DUPLICATES OF No. 740 & 742)	GOT. LR 20.9.56 RF 29.3.57	GOT 14.11.56

Fig. 5.—New Construction Record Card—A Sample Builders' Card

A = Yard or Design Number. B = Length, tonnage, type and Owner. C = Date of receipt in HQ of preliminary information and/or Survey Request Form. D = Date of receipt in HQ of Midship Section. (Note: Where plan dealt with at Plan Approving Centre other than HQ, the Port is indicated)

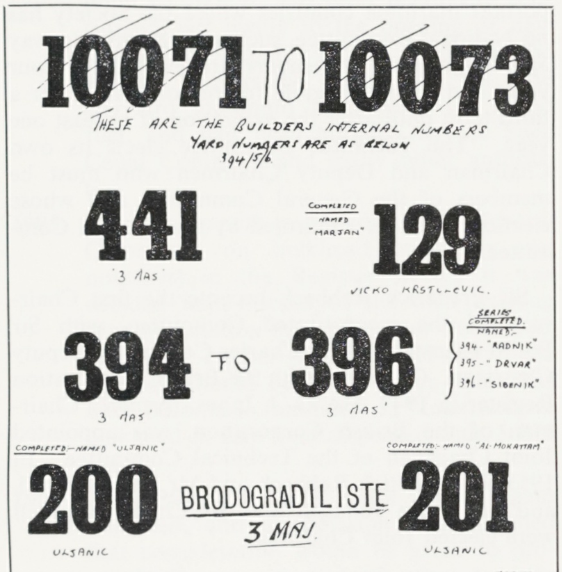


Fig. 6.—A Typical Constructional Folder

(2) The maintenance of Lists of Approved Establishments and other items such as electrodes, steel wire rope works, electrically welded and cast steel chain cable makers, aluminium manufacturers, steelworks manufacturing P 403, P 5 and X.N.T. steel, etc.

These are covered by a series of simple card indexes, and a correspondence system similar to that for the new construction, except that the records are retained permanently in the departmental files.

(3) Last but not least, the maintenance of records of all special subjects and technical questions of an unusual or general nature which arise in connection with ship construction, materials, equipment or research. These, as may be imagined, go back for a great many years; it is surprising how many technical problems which at first sight seem new have previously arisen in principle and been studied in the past, and it is the duty of the department to produce any precedent or analogous case for current reference. This is accomplished by a system of special files and an elaborate method of cross-indexing.

A feature of the general arrangement and a valuable safeguard is the "Endorsement Book" in which copies of all special statements and memoranda are kept and indexed for permanent record.

The effectiveness of the system, no matter how simply organised, depends on integrity in operation and in this, full tribute is paid to the staff concerned.

The contents of this section go beyond the title of the paper, to the extent that they deal with both shipbuilding and engineering matters, the records of which are in the Author's care not as administrative head of the Ship Department, but in his capacity as Clerk to the Technical Committee.

Lloyd's Register of Shipping as originally constituted was governed by a Committee consisting of representatives of shipowners, merchants and underwriters. In those days, when technical Rules were framed or alterations to existing Rules contemplated, opportunity was taken to ascertain the views of shipbuilders, but it was not until 1890 that shipbuilders and engineers had any direct representation. In that year it was decided to admit 12 shipbuilding and engineering representatives to serve on the Sub-Committee for Surveyors when questions relating to the alteration or framing of Rules for the construction of ships and machinery were to be considered. These members were elected by the Institution of Naval Architects, the Institution of Shipbuilders and Engineers of the North East Coast, and the Institution of Engineers and Shipbuilders in Scotland, each returning two shipbuilders and two engineers. In 1897 the representation was extended to include two steelmakers, their election being vested in the Iron and Steel Institute.

The first meeting of this Technical Sub-Committee was held in 1892, when the members had before them alterations prepared by the Chief Surveyor, Mr. Martell, to the Rules for anchors and chain cables for iron and steel ships, beams, floorplates and cementing of bottoms; and a number of amendments proposed by Mr. (later Dr.) J. T. Milton, Chief Engineer Surveyor, relating to feed pumps, boiler shells, and a modification of the requirements regarding furnaces.

The procedure was that the Technical Members met informally in the morning to discuss the proposals, and the full Committee sat in the afternoon under the Chairman of the Society, accompanied by the Deputy Chairman and Chairman of Classification, the Chief Surveyors and Secretary being in attendance. The afternoon meeting commenced at 1.30 p.m., which seems to have left the members little time for lunch—an indication of the stern devotion to duty, at the expense of material comforts, which was a feature of those Victorian days.

There was great controversy at those early meetings. The first Steel Ship Rules had recently been issued, and the shipbuilders, some of whom disagreed with many of the provisions, did their utmost to press their views. Their recognition at this time was confined to representation on this Sub-Committee, and it was not until 1911 that the constitution of the Society was extended to enable representatives of shipbuilders and engineers to be elected to the General Committee, and thus to have a direct part in the management of the affairs of the Society.

The first recorded chairman of the technical members was Mr. A. E. Seaton, who was succeeded at the beginning of the century by Mr. Henry Withy, and then by Mr. W. H. Dugdale, who acted from 1914-1928. Thereafter Mr. (later Sir) Frederick Rebbeck acted as the technical members' spokesman until 1947.

In 1947 the Technical Committee was re-formed as a separate body under its own chairman, and now consists of 59 members (shipowners, underwriters, shipbuilders, engineers, steelmakers, electrical engineers and others) elected by various bodies representative of the different sections of the industry, together with representatives nominated by the General Committee, Technical Committee and the Society's National Committees in the various maritime countries, namely, the American, Australian, Canadian, Danish, French, Holland, Italian, New Zealand, Spanish and Swedish Committees.

Representation from overseas has recently been widened by the election of members from important maritime countries where the Society has no National Committee, such as Belgium, Norway and Yugoslavia. Members are elected for four years and are not eligible for re-nomination for a third term until after the expiration of at least one year. The Technical Committee elects its own Chairman and Deputy Chairmen who must be members of the General Committee, and whose elections must be confirmed by the General Committee.

Sir Frederick Rebbeck became the first Chairman of the reconstituted Committee, with Sir Philip Johnson and Sir Charles Connell as Deputy Chairmen. On fusion with the British Corporation Register in 1949, Mr. G. J. Innes, formerly Chairman of the British Corporation, was appointed Joint Chairman of the Technical Committee. In 1953 Sir Frederick Rebbeck and Mr. Innes retired, and Sir Philip Johnson and Sir Charles Connell were elected Joint Chairmen.

Panels of the Committee are appointed to consider extensive Rule revisions and other matters of importance, and the constitution permits the co-option to these Panels of experts in the particular subject who are not members of the Committee. Special matters are discussed in detail at the Panel meetings, and when the Panel has reached agreement its report is referred to the Technical Committee for consideration. All decisions taken by the Technical Committee must be ratified by the General Committee, and new Rules or alterations to existing Rules become operational, unless otherwise decided, six months from the date of their adoption by the General Committee.

Some highlights among the matters dealt with by the Technical Committee throughout the earlier years, up to and including the major Rule revisions which followed the conclusion of World War I, are recorded below:—

1894 The first Rules for Electric Light on Board Ships were adopted.

1896 Rules for Turret Ships were approved.

1898 The first Rules for Refrigeration (special sub-Committee).

1900 Amendments to the Rules for Steel Testing, including a requirement that the steel must be of open hearth quality and be so certified by the makers.

1902 The first Rules for Burning and Carrying Liquid Fuel were considered and approved. The principles underlying the proposed conditions were that each fuel compartment should be well ventilated and sufficiently strong to withstand the motion of the oil when only partly full and the vessel in a seaway, and also the prevention of damage to cargo or of fire in the engine room compartment from any possible leakage of compartments or pipes.
At this meeting the well-known flash point of 150° F. was adopted. A minimum flash point of 200° F. had been previously considered, but owing to the opening of new sources of supply 150° F. had become almost universally recognised as the standard minimum flash point for liquid fuel, and had been adopted by the Suez Canal Company and many other authorities.

1905 A special report was made to the General Committee on bulkhead omissions and notations in the Register Book; it was decided that instead of the then existing type of notation in the Register Book, e.g., "For the Timber Trade 5 BH only" the notation should be in the form which has since become so familiar, i.e., "Intermediate bulkhead in fore hold dispensed with, 5 BH only".

1906 The Steel Testing Rules were again amended, and a provision was included that consideration would be given to proposals for use of steel of other tenacity than provided in the Rules.
At this meeting, also, alterations to meet cases of buckling of deck plating were considered. The Committee approved proposals put forward by the Chief Ship Surveyor for amendment to the Rules regarding upper structures of ships "so as to resist the tendency to buckling of deck plating under the more severe methods of loading or ballasting which were becoming prevalent".

1908 The requirements for testing of oil tanks in ships intended to carry petroleum in bulk were revised.
It had been decided in 1889 that the tanks of oil-carrying ships should be tested to a head of water 15 ft. above the crown of the tank. After further consideration of the whole question, the Committee adopted an amended Rule to require the pressure to be obtained by means of a head of water 8 ft. above the highest part of the expansion trunk.

1909 A complete revision of Steel Ship Rules was adopted. The new Rules and Tables provided for one grade of classification (**100A1**) only, but made provision for a ship built with suitable scantlings not quite equal to the **100A1** class to receive the **90A** class if the Committee approved. A section was included giving the first scantling Rules for Oil Tankers.

1910 The first Rules for Survey of Internal Combustion Engines for Marine Purposes were adopted.

1912 Requirements were introduced to provide additional scantlings of deck beams, girders and pillars when carcases of meat such as chilled beef, were hung to the hold beams "in order to enable them successfully to resist the additional stresses brought upon them by this mode of carrying the cargo". The omission of cargo battens, previously allowed in ships engaged in carrying coal, ore or wood, was extended to cargoes of pig iron, pitch, coke, case oil, or china clay; in each case the classification certificate to have written on it "Subject to the vessel being engaged exclusively in carrying . . . while without cargo battens".
In this year, also, the Committee authorised instructions to Surveyors concerning tests not prescribed in the Rules for steel and other materials. It was reported that "the Society's Surveyors have frequently to test steel materials to other specifications of tensile strength, etc., than those prescribed in the Rules, and also have similarly to deal with other constructional material as to which the Rules make no provision". It was agreed that a pamphlet be issued embodying these instructions, for use where parties interested may desire to avail themselves of the services of the Surveyors for testing work.

1914 The first Constructional Rules for Diesel Engines were adopted.

1918 The first tentative regulations for electric welding in ship construction were approved, following upon experiments carried out under the direction of the Chief Ship Surveyor at the works of Messrs. Cammell Laird & Co.

1921 A complete revision of the Steel Ship Rules was dealt with by a Special Sub-Committee.

1922 The first Rules for Water Tube Boilers were approved.

1923 The first Rules for Strengthening for Navigation in Ice were considered and adopted.

The tensile limits of ship steel were altered from 28-32 to 26-32 tons per square inch, following upon satisfactory experience of the lower limit of 26 tons with steel supplied from the U.S.A. during and after the war.

1925 Revised Tanker Rules, based on the longitudinal systems of construction, were approved after consideration by a special Sub-Committee.

ANCHORS AND CHAIN CABLES

In the earliest copy of Lloyd's Register extant, dated 1764, the classes assigned to ships were designated by the letters A, E, I, O, U, and the equipment by the letters G, M, B (meaning "Good", "Middling" and "Bad"). One hesitates to think what the attitude of an owner would have been towards a Surveyor who had proposed that his ship be classed U.B.

In the Register for 1775 the class **A1** first appeared, and the designation for equipment was altered from G, M and B to the figures 1, 2 and 3. The figure 3 was later dropped; the figure 2 was retained until 1878, since when the equipment has been designated by the figure 1 only.

The first reference to iron cables appeared in the Register Book in 1813 when an entry of "Iron Cable" appeared against certain ships. In 1816 the notation PIC (Proved Iron Cables) was added indicating that in those early days, before any regulations were framed, Lloyd's Register of Shipping was concerning itself with the testing.

When the Society was reconstituted in 1834, the length of chain cable and number of anchors to be supplied were based on the tonnage of the ship. No sizes of chain were indicated and no tests specified.

In 1858 a Table was adopted embodying sizes and lengths of chain cables, to be *recommended* when the Surveyors were applied to by shipbuilders and shipowners. This was also based on the tonnage of the ship. The requirements ranged from 120 fathoms of 11/16-in. chain at 50 tons to 300 fathoms of 2⅛-in. chain for ships between 700 and 2,000 tons.

In 1863 these requirements were made compulsory, the sizes and lengths required were adjusted slightly, and the Table extended to 3,000 tons, at which 360 fathoms of 2¼-in. chain were required. Weights of anchors in association with a test load were also inserted. The following note was added to the Table:—

"For steamers the anchors and cables will not be required to exceed in weight and length those of a sailing vessel of two-thirds their total tonnage."

In 1867 a separate Table was published of chains and anchors for steam vessels. This was still based on the tonnage of the ship, and the requirements ranged from 120 fathoms of 11/16-in. chain at 112 tons and under, to 300 fathoms of 2 1/16-in. cable at 3,700 tons.

In 1870 an equipment number was introduced into the Rules for Iron Ships, and appeared in the Table in association with the divisions of tonnage. The requirements were substantially the same, but the Table was afterwards extended to 5,000 tons, at which 300 fathoms of 2 5/16-in. chain were required. In 1882 the Table was extended to 7,000 tons at which 330 fathoms of 2½-in. chain were required.

In 1889, when the Rules for Steel Ships were published, an equipment letter appeared in the Table in association with the equipment number, the divisions of tonnage being retained, the requirements for anchors and for size and length of chain remaining substantially unaltered. In 1890 the "tonnage" quoted in the Table was defined as "gross Tonnage less crew space".

In 1893 an amended Table was published, the effect of which was to make a reduction of 30 fathoms in the length of chain required for ships between 675 and 7,000 tons, the corresponding size of chain remaining unaltered. In subsequent years the tonnages given in the Table were omitted. In 1900 the Technical Committee adopted a proposal that "where erections are fitted on erections the equipment is to be increased in the same proportion", and when the Rules were revised in 1909, and again in 1921, alterations were made in the method of computing the equipment numeral, and the Tables were expanded, but the requirements of length and size of chain cable for a corresponding size of ship remained on substantially the same basis as in 1893.

Anchors and Chain Cables Acts

The first Government legislation was in 1864 when an Act was passed in the U.K. for "Regulating the Proving and Sale of Chain Cables and Anchors". This Act was amended in 1871 and again in 1872 and 1874. Copies of these Acts are preserved in the Departmental records.

The opening words of the 1864 Act are: "Whereas it is essential, for the better Security of Lives and Property afloat in Seagoing Ships, to make Provision for the proper testing of Chain Cables and Anchors: Be it therefore enacted . . .". This Act required anchors and cables to be tested at establishments licensed by the Board of Trade. It was followed by the opening of the first Public Proving Houses (at Netherton and Tipton) in 1865, and later by other similar establishments.

The 1871 Act lists the corporations and public bodies to whom licences to test anchors and chain cables may be granted, and the first entry on this schedule is:—

The Committee of Lloyd's Register of British and Foreign Shipping for machines at London,

Bristol, Tipton, Netherton, Saltney, Monkwearmouth, Sunderland, and Low Walker, or elsewhere.

Other bodies recognised for this purpose included certain Harbour and River Commissioners and also the following: —

The Mayor, Aldermen and Burgesses of Bristol for machines at Bristol; The Undertakers under the Bute Docks Act, 1865, and the Bute Docks Act, 1866, for machines at Cardiff; The Mayor, Aldermen and Burgesses of Kingston upon Hull for machines at Hull.

Subsequently the control of testing operations at the Public Proving Houses in the U.K. was vested by the Board of Trade in the Committee of Lloyd's Register of Shipping and superintendents were installed under their direct control; this arrangement still stands.

The last Government legislation on this subject is contained in the Anchors and Chain Cables Act of 1899, which is still in force but much overdue for revision.

The interpretation under this Act that all anchors and chain cables for ships of British registry are to be tested at a Public Testing House in the U.K. has recently been modified by the Ministry of Transport, and it is not now required that anchors and chain cables manufactured abroad, intended for a ship of U.K. registry building outside the U.K., need be sent to a Proving House in the U.K. for testing; the Society's Test Certificate at the country of manufacture is accepted.

Approved List of Chain Cable Works

In view of the developments in recent years of the manufacture of electrically welded and cast steel chain cables, an Approved List of these makers was instituted in 1954. The current List contains the names of 48 such establishments, situated in 14 countries. The works are subject to annual inspection.

Anchors

As stated earlier, weights of anchors in association with the test load were inserted in the Society's 1863 Rules. Very little change has taken place in the requirements for anchors since then.

There is in the Ship Department records a copy of a publication issued by the Society on the 1st February, 1878, giving particulars of "The Tensile Strain to which Anchors are required to be subjected under the Chain Cables and Anchors Acts, from 120 cwt. to 1 cwt.". The proof strains given are identical with those contained in our 1958 Rules.

When stockless anchors began to be made during the latter half of last century, the various designs were required to be submitted to the Society and approved before their use was permitted in classed ships. The first record of such approval is in 1887 when Wasteneys Smith's "E" stockless anchor was accepted. Next were the Halls stockless anchor approved in 1888, and the Tyzack triple-grip stockless anchor in 1889. These anchors are still on our Approved List, which now contains particulars of 110 anchor designs associated with 65 companies.

STEEL WIRE ROPE WORKS

The question of acceptance of steel wire ropes for ships' equipment first received the consideration of the Committee in 1883 when a circular in the following terms was issued: —

"When steel wire towlines, hawsers, or warps are adopted, a short length of each of the wires composing the towline, etc., will be required, after being galvanised, to withstand a tensile stress equivalent to that set forth in Table 22, and the aggregate strength of the wires must not be less than 10 per cent in excess of that stress.

"Each wire will be required to be capable of being twisted around itself not less than eight times, and of being untwisted and straightened without breaking.

"Each manufacturer to be required to provide on his premises machines suitable for satisfactorily making the foregoing tests, and the works to be at all times open to the inspection of the Society's Surveyors, who are to be empowered to retest any hawser or towline for which a certificate has been issued by the manufacturer.

"Printed forms of certificates, approved by the Committee, to be given by the manufacturers of steel wire hawsers, will be supplied to them upon application to the Secretary."

No records are available of the original arrangements made for inspection of these establishments but in the early part of the present century, on application from a maker, his works was inspected and reported on by the Surveyors and if the report was satisfactory the maker was authorised himself to issue certificates on the Society's form. In the letter of approval at that time the Surveyors were required to explain to the maker that these certificates would be recognised by the Committee only upon the understanding that the Surveyors would at any time be at liberty to make occasional visits to the works and make check tests upon any ropes which might be in process of manufacture. The maker was also asked to give an undertaking to use only steel wire possessing the required tenacity and ductility to satisfy the Society's requirements.

Several steel wire rope works in the U.K. received this authority and later it was extended to wire rope works on the Continent of Europe, the first record being of one approved in Germany in 1906.

Between 1920 and 1939 over 50 steel wire rope works outside the U.K. were so inspected and

approved; the greater number of these were in Germany and others in Norway, Sweden, Belgium, Czechoslovakia, Russia, Japan and Australia.

In 1948 it was decided that a list of Approved Steel Wire Rope Works should be issued, and that each establishment should be subject to biennial inspection by the Society's Surveyors. At the same time the Rules were altered, and detailed requirements inserted in the section on Quality and Testing of Materials governing the manufacture and testing of steel wire ropes.

Originally two certificates were issued, Cert. 3 for steel wire hawsers and Cert. 4 for steel wire rigging. When the Rules were altered in 1948, Cert. 4 was discontinued and one certificate (Cert. 3) was issued, headed "Certificate for Steel Wire Hawser or Rigging".

Later, in 1956 it was found that in some cases these certificates were being used by makers for steel wire ropes for non-marine contracts. This led to misunderstanding and a circular was issued making it clear that Cert. 3 was only to be issued by the makers for the testing of steel wire ropes intended for the equipment of classed ships and that in any other cases, where purchasers required tests to be witnessed by the Society's Surveyors, special certificates would be issued. A note to this effect was embodied on Cert. 3.

This is the only known instance in our history where a manufacturer is authorised himself to certify on the Society's form that the Rule tests have been carried out. It is unique in that respect, presumably due to the impracticability of arranging for the Surveyors to attend at these works to carry out individual tests on miles and miles of steel wire ropes which may be continuously produced.

The first Approved List contained the names of 66 Steel Wire Rope Works, 36 of which were in the U.K. The current List contains 125 works in 17 countries, 37 in the U.K. and 88 abroad.

APPROVED MAKERS OF ALUMINIUM ALLOYS

No ocean-going cargo ship has yet been built wholly of aluminium alloy; designs have been dealt with, but no project has yet materialised. In view of the great extension of its use for certain parts of the structure, the Society in 1947 issued Tentative Requirements for Aluminium Alloys in Ship Construction, and after 10 years' experience these have just been revised and made permanent.

A number of small craft (yachts and launches) constructed of this material have been built under survey and classification assigned.

The first Approved List, issued in 1950, contained 15 works, 11 in the U.K. and four on the Continent of Europe. The current List contains 40 works in 13 countries, including 16 manufacturers in the U.K.

Special tests are laid down for first approval, and thereafter the inspection arrangements are as for steelworks, the establishments being subject to triennial inspection but the testing machines annually.

CONCRETE SHIPS

Concrete ships were built during both the World Wars, on account of the shortage of steel. Owing to their excess weight they have never been an economic success, and with a few exceptions had short lives. When each war ended many were laid up, some used as coal hulks, and others were used to form wharves or breakwaters.

During the period 1914-1919, 56 ferro-concrete ships were built in the U.K., under the supervision of Lloyd's Register of Shipping for classification. Forty-two of these were barges, 180 ft. long; 11 were tugs, 125 ft. long; and three were coasting steamers ranging from 125 ft to 205 ft. in length.

The barges and tugs, which represented the majority, were built on three systems:—

1. Wholly monolithic.
2. With pre-cast frames, beams and floors, otherwise monolithic.
3. All pre-cast.

The steel for reinforcement was required to be tested in accordance with the Rules; the cement to comply with a standard specification; and the concrete was subjected to compressive tests and permeability tests. During both wars an expert in concrete construction was employed by the Society for consultation in dealing with structural plans and to join in the survey during construction.

The classes assigned were ✠**A1** with suitable service notations, and with the additional notations "subject to annual survey" and "experimental". As a result of experience, the notation "experimental" was subsequently removed in some cases.

An interesting case was the ferro-concrete coasting steamer *Armistice,* completed in 1919, which proved successful in service, and retained her class until 1930. The class was withdrawn, but she continued to trade under the Portuguese flag and under another name until 1936.

Larger concrete ships were built in the U.S.A. ranging from 260 ft. to 420 ft. in length, including bulk ore carriers. Some of these were built to Lloyd's Register of Shipping classification, and it is known that some lasted for many years. During the 1914-1919 period also, a number of concrete craft, mainly barges, were built in other European countries, particularly in Norway.

During the 1939-1945 war, several concrete ships were again built in the U.K. to Lloyd's Register of Shipping of Shipping class, the most important being the ferro-concrete coasters *Lady Wolmer* and *Lady Kathleen*, each 265 ft. long, built in 1942 and 1943 respectively, and classed ✠**A1**, "subject to annual survey". The class of the *Lady Wolmer* was at first restricted to carriage of coal cargoes, but after two years' service this qualification was removed. The *Lady Kathleen* was wrecked in 1951, and the *Lady Wolmer* was similarly lost in 1953. A number of small concrete barges (107 ft. long) were also built for river services.

There are no ferro-concrete ships now holding the Society's class, and only seven appear in the 1958 Register Book.

On one occasion the completion of a concrete ship was signalised by a visit of V.I.P.'s headed by a high Government official. The party was walking along the deck, and its leader, congratulating all concerned, was asking whether it was really true that a structure of this sort was strong enough to bear the stresses of a ship at sea. The structural design, and the part played by the reinforcing bars were explained to him and he was assured that the strength was in every way equivalent to that of a steel ship. At that moment a workman staggered across a part of the deck which had only just been concreted carrying a heavy air bottle, and in trying to avoid the party of visitors he dropped it. It happened to land on a soft spot between two reinforcing bars and went right through the deck, disappearing into the hold below. Our Surveyor quietly and unostentatiously disappeared, and the party broke up in confusion.

ELECTRIC WELDING IN SHIP CONSTRUCTION

The earliest record of the use of electric welding for a classed ship was in 1906, when some small repairs to the combustion chamber seams of a boiler were reported. These on subsequent examinations were found to be satisfactory, and between 1906 and 1911 this process was used for a number of repairs both to boilers and hulls. The hull repairs consisted mainly of welding up flaws or cracks in sternframes or rudders and were only permitted as temporary. The experience in these cases varied; the majority were satisfactory but in two instances it was subsequently found necessary to renew the sternframe or rudder concerned. The growth of the use of welding for repairs in these early years is shown by the following table:—

	Boilers	Hulls
1906	2	–
1907	11	1
1908	44	1
1909	40	2
1910	37	10
1911 (6 mos.)	26	6
Totals	160	20

The Committee in 1911 decided that the time had not arrived for general and unqualified approval to be given for repairs by electric welding to important forgings or castings, and that for the time being they could only be recognised as temporary repairs, subject to examination from time to time in drydock.

During World War I appreciable progress was made in the technical development of electric welding. In 1917 extensive experiments were carried out in the U.S.A. and similar experiments were conducted by the British Admiralty at Portsmouth. These tests were mainly confined to the determination of the ultimate strength of welded joints, and it was felt to be desirable, before consideration could be given to the application of welding to the structural members of a ship, that information should be obtained about the physical properties of the deposited material and the ability of the welded joints to resist the alternating stresses to which ships were subject.

With this object in view, Lloyd's Register of Shipping in 1918 undertook a comprehensive series of tests at the Works of Messrs. Cammell Laird & Co., Birkenhead. These were carried out under the supervision of the Chief Ship Surveyor and the general scope of the experiments included:—

(a) Modulus of elasticity.

(b) Determination of ultimate strength.

(c) Alternating stresses with
  (1) Rotating specimens.
  (2) Stationary test pieces.

(d) Minor tests such as
  (1) Coldbending of welds,
  (2) Impact tests.

(e) Chemical and microscopic analysis.

The general results may be summarised as follows:—

(a) Modulus of elasticity of the deposited material did not differ greatly from that of steel.

(b) The ultimate strength of welded butt joints approximated closely to that of the parent metal in the joints.

(c) Round bars containing a butt weld have a fatigue limit of about 60 per cent that of a solid bar.
Somewhat similar results were obtained with the flat plate stationary specimens.

(d) Welded butt joints have only a limited capacity to resist bending but can withstand impact with a considerable degree of success.

Broadly, the results of these experiments established that when the welding was done by experienced operators, under conditions favourable to good work, fracture of the weld did not take place along the plane of adhesion between the weld and the parent metal; that the deposited metal possessed a high ultimate strength limit

which was, however, associated with a relatively low degree of ductility; and that the resistance of the welded joint to repetitive and alternating stress conditions was less than that of ordinary mild steel.

Shortly after these experiments had been completed, Messrs. Cammell Laird & Co. decided to build a ship in which electric welding should totally displace riveting. This was the *Fullagar,* later re-named *Shean,* 150 ft. x 23·5 ft. x 11·5 ft.; she was constructed under the supervision of the Society's Surveyors and classed ✠**100A1** "Electrically Welded", "Subject to Annual Survey", "Experimental". Completed in 1920, this ship saw 17 years of arduous service and as a full scale experiment was an unqualified success. The requirement "Subject to Annual Survey" was modified after some years to "Biennial Survey" and the notation "Experimental" was deleted in 1933. For some time she was employed in transporting steel material between South Wales and Liverpool. In 1924 she grounded in the River Mersey and was so severely damaged that the Underwriters agreed a total loss, but in spite of this the ship was satisfactorily repaired. The bottom was set up from bilge to bilge for a distance of 30 frame spaces fore and aft, the greatest depth being 11 ft. 2 in. The floors and keelsons were buckled, as were also the bulkhead, deck plating and beams. The welding of the shell plating had not been damaged or started. No plating was removed, and the bottom as a whole was faired by means of shores and hydraulic jacks. This caused quite a sensation at the time. Later, the ship was engaged in carrying cement on the coast of British Columbia, and in 1930 charged a rock at full speed inflicting severe damage on the bow, and was again successfully repaired. She was sunk by collision off California in 1937.

The Committee in August, 1918, issued "Tentative Regulations for the Application of Electric Arc Welding to Ship Construction", the first Rules of this kind to be published. These provided for the approval of proposed systems of electric welding, laid down certain conditions designed to secure satisfactory workmanship, and made some requirements as to details of construction. They were supplemented in 1922 by a Notice supplying a complete statement of the Committee's Regulations and practice in this matter. The first Approved List contained the names of six electric welding processes, namely: —

The Alloy Welding Process Ltd.

The Blohm & Voss System.

The British Arc Welding Co. Ltd.

The Kjellberg System.

The Quasi-Arc Co. Ltd.

The Wilson Plastic Arc System.

By 1931 the List contained 13 names, seven additional processes having been approved, namely: —

La Soudure Electrique Autogene S.A. (Procedes Arcos).

N.V. Willem Smit & Co.'s Transformatorenfabriek (Elarc Electrodes).

The Agil or Agile System.

The Bohler Elite System.

The Ferro-Arc Welding Co. Ltd.

The Premier Electric Welding Co. Ltd.

The Whitecross Company Ltd. (Arco Ingot Iron Electrodes).

In 1932 the Committee adopted amended Rules for Welded Construction and for the Testing of Electrodes. The most important change was the inclusion of specific requirements regarding the ductility of the deposited metal for welding parts of primary structural importance.

While by this time there was continued extension of the employment of electric welding for various structural parts, no more all-welded seagoing cargo ships had been built and the next was the *Moira,* 240 ft. in length, the first all-welded ocean-going tanker, constructed in 1935 by Messrs. Swan, Hunter & Wigham Richardson and classed ✠**100A1** "Carrying Petroleum in Bulk". This ship, which proved satisfactory in service, was followed by others.

In 1937 revised Regulations for the Testing of Electrodes were adopted. These contained two entirely new requirements, firstly, that the makers must provide with every packet of electrodes a guarantee that they were of the same materials and by the same process of manufacture as those originally tested; and secondly, that all electrodes must be subject to periodical tests at least once in a calendar year.

Following upon the phenomenal advance in all welded construction during World War II, the Rules were again revised in 1945, and the present requirements are well known.

A feature of this revision was the approval of electrodes for positional welding and they are now designated on the List as approved, either for welding in all positions or for downhand, vertical or overhead welding.

In 1954 tests for deep penetration electrodes were inserted into the Rules and electrodes which have complied with this requirement are indicated on the Approved List by means of an asterisk.

An indication of the stages of development may be gained from the number of electrodes on the Committee's Approved List during representative years, namely: —

1920	6	Processes
1931	13	Processes
1933	48	Electrodes
1939	244	Electrodes
1950	487	Electrodes
1956	1,065	Electrodes
1958	1,204	Electrodes

From the beginning the control of the quality of electrodes at the makers' works has been considered of cardinal importance. Every electrode entered on the Approved List must be satisfactorily tested annually, and the annual inspection also includes a report on the works and plant to ensure that there has been no change since the establishment was originally approved. It is a

common practice for many makers to manufacture under licence an electrode which has already been approved for another company, and in these cases the full series of tests is not insisted upon, provided a written guarantee is received from the parent company that the materials used and methods of manufacture of the electrode at the associated company's works are identical in all respects. The electrode is then submitted to annual tests, and entered on the Approved List in italics below the name of the parent company, who remain primarily responsible. If this guarantee is not forthcoming, the full Rule series of tests must be carried out.

Automatic electric-arc welding commenced with the Unionmelt Process as originally operated by the Linde Air Products Co., U.S.A. In 1939 there were only two names in the Automatic section of the Approved List, the Linde Company and Elektriska Svetsnings A/B (Esab) of Sweden. In view of the rapid developments since World War II, approved automatic electrodes are now listed under three sections, namely:—

Submerged Arc Process
Gas Shielded Process
Coated Electrodes

The List of Approved Electrodes, which began so modestly, is now a major publication, and the administrative work connected with it is considerable. The present List contains particulars of 1,204 electrodes made by 172 firms in 30 countries, including 83 automatic electrodes and four oxy-acetylene filler rods. Electrodes which are approved for deep penetration number 117.

FRAGMENTS

The use of aluminium alloys in ship construction is regarded as a modern development. The Ship Department records show that in 1895 a firm of aluminium manufacturers in Switzerland approached the Society with a view to obtaining approval for building ships.

Samples were submitted consisting of short lengths of: (1) aluminium, (2) an alloy of aluminium and iron, and (3) an alloy of aluminium and copper. These were subjected to tensile bending, hammering, punching and welding tests. The results were:—

(1) The pure aluminium samples proved to be soft, with a mean breaking strength of 9 tons per square inch. They had good ductile qualities, but were deficient in stiffness and in the working qualities usual with iron and steel.

(2) The tensile strength of the alloy of aluminium and iron was slightly greater than that of the pure material, the mean of two tests being 11·2 tons per square inch.

(3) Samples of the aluminium and copper alloy gave a mean tensile strength of 19 tons per square inch, but the actual breaking strengths varied from 15 to 22·1 tons per square inch, which showed want of uniformity. The punching and bending tests showed the working qualities of this alloy to be not equal to those of iron used for ordinary shipbuilding.

None of the samples could be welded, and when heated even to low temperatures they broke at once into small fragments.

The Chief Surveyors recommended that these materials were not suitable for building ordinary sea-going vessels; and the General Committee, who had the case before them in April, 1896, decided that the manufacturers should be informed accordingly.

The question of loading and ballasting of ships is a live subject today, on which the Society in recent years has issued guidance notes to shipowners. The following is another extract from the writings of Sir Walter Raleigh:

"And whereas now the cookrooms in all our ships are made below in the hold in the waste, the inconveniences thereof are found many ways by daily use and experience. First it is a great spoile and annoyance to all the drink and victualls where are bestowed in the hold, by the heat that comes from the cookroom. Besides, it is very dangerous for fire and very offensive with the smoake and unsavory smells which it sends from thence. Moreover, it is a great weakening to a ship to have so much weight and charge at both ends, and nothing in the midship which causeth them to warp, and (in the sea-phrase; and with mariners) is termed Camberkeeld; whereas if the cookrooms were made in the forecastle (as very fitly they might be) all those inconveniences would be avoided, and then also would there be more roome for stowage of victualls or any other necessary provisions."

To turn aside for a moment from matters technical, the Author hopes that the following poem, found in the early records will give readers as much pleasure as it did him:

The sea is a woman, charming and deep,
Haunting a million of men though they sleep;
A sweetheart whose bosom is pulsing and warm,
A vixen who taunts them in tempest and storm;
A mother-like being, she gives from her heart,
The catch for a crew, and fish for the mart;
And often she dances beneath a great moon,
While a sailor is singing a voyager's tune—
I know she's a woman—she has to be,
For so many men are in love with the sea.

The correspondent who asked that the Society would delve into its archives and produce authentic particulars of the construction of the Ark. The writer enclosed technical calculations of stability, deadweight, etc., based on the available Biblical information, and in such detail that they included an allowance for fertility of the cargo during the voyage.

The occasion when a remote port ran out of printed forms of application for surveyorship, and sent in an abbreviated typewritten form in which "Married or Single" had been rendered as "Married or Sin"! Against this item the candidate had entered "No Children".

The Principal Surveyor whose favourite phrase in official recommendations to the Committee was that if the action advocated by him was taken "good would accrue".

The application received from an inmate of one of H.M. Prisons for guidance on a course of Naval Architecture which he could study, apparently in the hope that "when free" he could obtain an appointment on the Society's Staff.

Two sayings by Dr. Montgomerie, that master of the English language:

(1) In dealing with the case of an unsatisfactory survey carried out by a Surveyor who had been kept on beyond the normal age: "Mr. — is now nearly 70 years of age, and is obviously unable to climb about staging with that *detachment from considerations of personal safety* which is necessary for an effective survey of the structure".

(2) In speaking of successive developments which had taken place in Government Regulations relating to subdivision etc:

"What has been the result of all this devoted study and detailed legislation? One result has been the enrichment of the vocabulary of scientific jargon by the inclusion of many exotic terms not previously familiar to us in shipbuilding."

A favourite remark of Sir Andrew Scott's, made to the Author on many occasions when he posed an awkward question: "We'll cross that bridge, me boy, when we come to it!"

The Owner who when approached about a decision to transfer the class of a ship away from L.R., blamed the builder; the builder, when approached, said the owner was responsible. It was later found that the same man was both owner and builder.

The Surveyor who, when amending the plans for a new ship, left out a rule bulkhead; and when confronted with the fact on completion of the ship said "Well, we'll just need to put it in".

The occasion of the marriage of a much loved colleague, when Sir Andrew Scott, on behalf of the Staff, presented him with a magnificent watch, and observed that there would be no excuse for him arriving late at the office in future. The recipient, in responding pointed out that the gift would be much more useful in letting him know when it was five o'clock and time to go home.

The Principal Surveyor who, when transferred to H.Q., could not remember anybody's name, and delighted all and sundry by addressing everyone as Mr.-er-er. This applied even to his Chief, the only difference being that he addressed him as Dr.-er-er.

The case of rudder damage reported from an outport overseas, where the damage was of such an unusual nature that, after consideration in H.Q., a letter was sent to the Principal Surveyor of each country asking if any similar incident had ever been experienced in their districts. By inadvertence, the letter was sent also to the country from which the original report had been received, and a reply was received from the Principal Surveyor saying that they had no experience of any case of that sort in his country.

It is interesting occasionally to look back on the past and to recall how the Society, even in the course of one lifetime, has gone from strength to strength. The future is more important and of this, so far as Lloyd's Register of Shipping and its work are concerned, the Author has never been in any doubt.

He would conclude by quoting a remark once made by Sir Westcott Abell which has always seemed to him to epitomise the essential reason for the Society's existence:—

"Nationality is of no importance to a ship in a winter gale; it is the *fitness of the ship* which is all-important."

PRINTED BY LLOYD'S REGISTER OF SHIPPING
AT GARRETT HOUSE
MANOR ROYAL, CRAWLEY, SUSSEX. ENGLAND

Lloyd's Register Staff Association

Session 1958-59

Paper No. 6

Discussion

on

Mr. C. V. Manley's Paper

SOME EARLY TECHNICAL RECORDS OF THE SHIP DEPARTMENT

LLOYD'S REGISTER OF SHIPPING

71, Fenchurch Street, LONDON, E.C.3

Discussion on
Mr. C. V. Manley's Paper

Some Early Technical Records of the Ship Department

MR. P. H. VAN DER WEEL (Rotterdam)

Mr. Manley's paper will particularly appeal to those who are interested in the history of our Society, *la petite histoire* as well as *la grande*.

Like the late Mr. Sladden in "Notes and Anecdotes on the Society's Staff during the Victorian Era", Mr. Manley speaks about several personalities. This surely must have stirred memories with all of us. Together with the ultimate chapter, "Some Light-Hearted Memories", this could easily trigger off an endless narration of anecdotes. Alas! to quote Mr. Murray: "The best ones must remain untold"; many anecdotes would not obtain the *Imprimatur*.

As a Ship Surveyor I feel indebted to Mr. Manley for having stressed on page one the word "superior", used by Sir Walter Raleigh when he spoke of the qualifications required of the man who should have "further regard in the business of building ships".

It is heartening to see how Mr. Manley touched here upon the earliest traditions of Lloyd's Register, as narrated by Mr. Sladden. In 1834 the required qualifications for the appointment of shipwrights read: "The Shipwrights shall be practical men, possessing the highest attainments of their profession to qualify them to judge of the quality and construction of ships, having general experience, capable of corresponding and competent, by a *superiority of talent* to undertake the inspection and survey of all matters that may arise relative to shipping concerns".

A superb piece of prose and for the Ship Surveyors a lofty ideal to look up to.

One wonders whether or not the Committee considered that similar prose should fittingly describe the qualifications required for the inspection of that new fangled "equipment" steam engines, some 40 years later and 40 years after the first appearance of steamships on the seas. Sir Ronald Garrett, when speaking on the subject in 1957, could quote no more than the term "Competent Master Engineers". In more modern times frustration might have overtaken our engineer colleagues. As things were they multiplied and became the worthy opposite numbers of the shipwrights, even capable of corresponding.

We all feel richer for possessing memories of our elders and predecessors, to whom we looked up with awe and respect. Several of them were such striking personalities that the memories we have of them are most colourful.

Mr. Manley has named great men at Head Office; I would like to add the name of Mr. Leeuwenburg, who from 1898 till 1940 served the Society in a brilliant manner. I wrote of him on another occasion, but would recollect now that he started his L.R. career in the era of the sailing ships, built of wood, iron and even steel, in the days that the harbours and quays of Rotterdam were packed with the hulls of these proud ships and the sky above full of masts, spars and rigging.

The last ones of these superb ships that used to trade to this port were the four-masted barques of Jakob Laisz of Hamburg and of Ericsson of Mariehamn.

In the early 'thirties I had quite a few of these steel sailing ships in drydock and even for Special Survey.

Mr. Leeuwenburg liked to visit these ships and on a memorable day I succeeded in twice causing his displeasure. The first occasion was when he saw me standing on the main crosstrees. I was forthwith shouted below and was sternly reprimanded that such acrobatic tours were dangerous, stupid and superfluous; wherefore, did I think, had he appointed a Second Surveyor, an expert rigger?

My second *faux pas* followed very soon when in the saloon aft I sat listening to a technical conversation between the Finnish Master and my Principal Surveyor. The conversation ran on masts, spars and rigging, with a jumble of rare appellations.

I soon found out that the two gentlemen were speaking at cross purposes, as each was using different names for what apparently were the same spars, ropes or smithwork.

My naval school time was then not so far behind me as it is now and I still remembered most of the fantastic four-language vocabulary extracted from Paasch and stuffed under my skull. So I volunteered to clarify, but was ill received, my disgrace this time lasting considerably longer.

The taste of it, however, at once disappeared when my narration in the office of what had happened brought out the story of the engineer colleague who paid one visit on board a sailing ship, had one good look at the Galloway-tubed little donkey boiler and another at the Master's strapping daughter, made a date with her for the *variété* (music hall) and was off, whilst the puritan Ship Surveyor had already made many visits on board without having achieved more than a Special Survey.

One of these four-masted barques—I think it was the *Passat*—sank the French collier *Circé*, or was it *Daphné*? off Beachy Head, whilst *Passat*

was on an outward voyage, loaded with cement. *Passat* put back to Rotterdam and had her starboard bow extensively repaired.

The next year, in the same month, outward voyage, laden with cement and off Beachy Head, she tried again to sink a ship, but this time was a little too ambitious in her choice: *British Lantern* was damaged but kept afloat. *Passat* returned to Rotterdam and had her bow extensively repaired, the only variation being that this time it was the port side.

Mr. BUCHANAN

I cannot, like Mr. Manley, go back to 1834 but I would like to comment on some of the statements he makes in the paper. He says that many technical problems which at first sight seem new have previously arisen in principle and been studied in the past. I can assure him, however, that most of the problems which have come before me in the past 30 years have been entirely new. In the Section on Electric Welding he says that the first Approved List was issued in 1920. The first List of Approved Electrodes, however, was prepared in 1932, as I well know, because I was dealing with this work in Head Office at the time.

This has been an evening of reminiscences and I am sure the Author will not mind me adding one, relating to the handwriting of our late colleague Mr. Ernest Potts. His writing was artistic but most hard to read and caused a certain amount of difficulty. On one occasion Mr. Manley got so tired of trying to decipher it that he typed an official statement containing the words as they appeared to read from Mr. Potts' handwriting, and the result was extraordinary.

Mr. MURRAY

I think you will all agree that we are very much indebted to Mr. Manley for this paper, and that for several reasons.

To start with, he has put down some of those records of the early days of the Society which might well be lost, and which are very valuable. And secondly, the historical part is most useful.

I would also like to take this opportunity of saying how much I and my side of the house owe to Mr. Manley and his department for the help and co-operation which they give us.

Mr. Manley has been indulging in reminiscences, and I suppose that is the main feature of this paper. Perhaps you will forgive me if I indulge in one or two also.

I cannot go back for 44 years, but I can go back for quite a long time when the London Office was a different place from what it is today. On the whole, I would say in those days it was more austere and formal, but more leisurely. I remember well that when I came down to London I was given one or two do's and don'ts about conduct in the London Office. One of the do's was "give Tommy Cox, the Chairman's Messenger, half-a-crown right away. Otherwise a lot of information which might be to your advantage will escape you". Certainly, in those days, the half-a-crown was money well spent.

Another bit of advice which I was given, which contrasts a little strangely with what Mr. Manley says about Mr. Watson, was "Don't say 'good morning' to Mr. Watson", and when I asked why, I was told that on one occasion a young Surveyor coming down to London had said 'good morning' to Mr. Watson and Mr. Watson had said: 'I hardly think, young man, that it is your place to start a conversation' ".

Many other similar instances come to mind, and I think I must tell you one reminiscence of Mr. F. Harwood. On one occasion he was playing golf in the Surveyors v. Clerical Staff match against Mr. Tom Pratt whom many of you may remember. When he was eight down and ten to go, Mr. Harwood, who didn't relish being beaten, said he felt faint and he was helped back to the club house and revived with brandy!

I recollect, too, Mr. W. Thomson telling me one or two stories of the famous Charles Buchanan.

C.B. was, I think one might say, rather a rough diamond in many respects, but he certainly, as Mr. Manley said, got the plans out.

Mr. Thomson's story was this:—

C.B. came to him one day and said, "Mr. Thomson, we are getting very scientific in the Plans Department. They are talking about I/y's. I understand the I and I understand the y, but can you tell me where the B comes in?"

I could probably go on for a long time with other stories of that kind. I think that anybody who has been in the Society over a period of time will be bound to conclude that we have gained a lot with the passage of the years as this assembly here shows. We have lost something, too, but I have a very strong impression that matters were conducted in a more leisurely way in the earlier days.

I remember seeing, in one of the Minutes of the Committee for Surveyors which preceded the Technical Committee, a report from a Surveyor who had been sent out to Japan to report on sheerstrake rivets in one or two of the ships which were being built there.

I cannot remember whether his report was favourable or unfavourable, but it took six months to do the job!

I again thank Mr. Manley for his paper and the personal pleasure it gave me to read it.

Mr. FOWLER

I would like to add my congratulations to the Author for his most interesting paper.

I would like, in the first instance, to emphasise that my following remarks are entirely concerned with the Administrative side of Ship Department. Any references to Ship Department should therefore be regarded in that light.

I speak as a comparative newcomer to the Ship Department—after all, ten years is but a twinkling of an eye when you realise that, since Mr. Harwood first established the Ship Department as an administrative unit in 1887, there have only been three heads, including our Author, in some 72 years.

Whilst this might infer that promotion in the Department is somewhat elusive, I think it is more true to say that the constancy of overall supervision has had a very great bearing on the efficiency of the Department over the years, and has enhanced its effective assistance to the technical staff.

Before being posted to the Ship Department, I had for some number of years—the greater part of my early career in L.R.—been a member of the Engineers Department. In the early days, we were located on the first floor of 71 on the opposite side of the passage to Ship Department, and I recollect very clearly a rather—to me—forbidding figure of a gentleman who seemed full of energy and a stickler for work, who always seemed to be popping in and out of our room and always with papers which appeared to require immediate attention. I soon found out he was Mr. Harwood and that it behoved me to treat him with great respect.

However, nurtured as I was on a mixture of high pressure steam and fuel oil, crankshafts and other revolving and reciprocating parts, I became, I'm afraid, convinced that the engineering side was without doubt the hub of the Society, and in my innocence I could never quite understand how such apparently static structures as hulls could possibly require such detailed attention and urgent priority.

Needless to say, it was not long after joining the Ship Department—even if I had not already become aware of the fact—that I realised that to be of any use a marine engine must have a hull, whereas a hull can function without an engine—even if it is only a dumb lighter.

Turning to the paper, I would refer to Fig. 1—the endorsement written in 1895. At the bottom left-hand corner you will note the references to the correspondence:—

Lr 26.11.95
Ansd 5.12

This practice introduced by Mr. Harwood—and indeed it is his handwriting—is still in current use in the Department some sixty-odd years later—a fair comment on its usefulness.

I now pass on to page 6 of the paper—the Ship Record System. This system was evolved over many years of experience, and I am glad the Author has thought it of sufficient importance to include in his paper.

Whilst you may feel I have a vested interest, being a member of the Ship Department, I would like to say that the system was already in full operation some very considerable time before my joining, and, I hope, therefore, that I am in order in making a few comments thereon.

We hear much to-day of office efficiency methods and I am sure that quite a few of those who visit the Ship Department must think we are still in the dim past with our old-fashioned filing boxes, which I agree compare unfavourably in the aesthetic sense with the streamlined metal cabinets seen elsewhere.

The criterion of a successful filing system is surely its ability to store correspondence neatly and yet permit of such correspondence being instantly available as and when required.

Thus, while there are many systems, the efficacy of any one system must be dependent on its successful application to the particular purpose.

In Ship Department, especially in these days when the elapsed time between approval of plans and final reporting on completion is now measured in years rather than months, the existing system has proved eminently suitable.

I have had experience of many systems, both in the office and during my service in the Army—where the Divisional Headquarters I was attached to was singled out by the War Office to be the guinea-pig for a completely new system of filing—and in my opinion we could not have a better system in the Ship Department and I would deprecate any change.

Once again, my thanks to the Author for his paper, and I hope we may have, in the future, similar papers relating to other departments in Headquarters.

Mrs. Tripp

I have looked carefully through the early part of this paper and I must say I wonder how the men muddled along in those days without the assistance of ladies.

I note that everything was written by hand, and after seeing the examples of the beautiful handwriting in the old records, I feel that things were done much more leisurely in Ship Department then. This beautiful writing seems, unfortunately, to be a lost art.

I wonder what some of the early members of the Staff would think if they were to come back into the Department, particularly, say, on a Friday afternoon and hear the mad pounding of typewriters operated by ladies.

There is also the growth of the various Approved Lists. For instance, I find it difficult to imagine the first List of Electrodes with only six names, as compared with the 1,204 recorded at the end of 1958.

The indexing of the endorsement book is referred to on page 7. This is known departmentally as "doing" the endorsement book, and a much unloved job—but not one of us would deny the great value of this seemingly old-fashioned method when special papers, either current or from the past, are urgently required.

And finally, of course, the sea is a woman—it's so unpredictable!

Mr. BATES

Mr. Manley has illustrated in his paper the growth of the Society over a span of some 125 years. Many technical developments have taken place in that time, and these are shown very clearly in the list of changes in the Rules given on page 9. It is quite clear, too, that any advances in science or technology are wholly dependent on the availability of previous knowledge. Ship records provide a reservoir of information to which each generation in turn adds its own genius.

Mr. Manley will forgive me if I say I am not ancient enough to reminisce with him over events which have occurred in the course of nearly two centuries and, consequently, my comments will be brief and confined to the lighter side of his paper.

It is well worth repeating what Sir Walter Raleigh said of the Surveyor: ". . . . if he be such a one hath more judgment in the building and conditioning of a ship than devotion to his own case and profit". The impartiality of the Surveyor cannot be better described today.

There was a football match between Surveyors and Clerks in 1919, and it appears from the photographs that nine Surveyors felt strong enough to take on a clerical team at full strength! It would be interesting to know by what margin the Surveyors won the game.

Mr. Bernard Waymouth, the Secretary, must have been a formidable figure in his day. Mr. David Masters, in his book "The Plimsoll Mark", makes reference to the Secretary's visit to a Clyde shipyard in the early 1870's. Seeing a number of iron plates which were to be used on a ship to be built under survey, Mr. Waymouth requested that some of the plates be tested to ascertain their quality. A plate was duly placed on a slab and a heavy blow was struck with a sledge hammer. To the astonishment of the onlookers, the plate splintered like a piece of glass. No time was lost in calling a meeting with the manufacturers so that the iron could be tested in their presence. It was eventually decided to test a plate by placing a corner of it over the edge of a slab and to strike it with a hammer to see how it would bend. Careful manipulation on the part of the workman bent the plate slightly, much to the manufacturers' relief. But the next blow sent the corner of the plate clanging to the ground. It was then requested that the plate be tested in the usual way, which was to select any spot on a plate at random, place the end of a punch in that spot and strike it with a hammer. If there was no sign of fracture, it was good iron. When the Society's representatives arrived, they were shown a new punch most beautifully made and with the sharpest of edges. A die was placed beneath the plate, and when the punch was struck immediately above the die, it cut through the iron as if it were paper. The trickery did not go unnoticed and the usual tests were called for. This time the plate fractured in all directions.

Brittle fracture exercised the Surveyor's vigilance then, much as it does to-day!

Finally, Mr. Manley should be thanked for a most interesting paper which will provide a natural pendant to the late Mr. Sladden's contribution on "Anecdotes of the Victorian Era".

Mr. JORDAN

In congratulating Mr. Manley on his remarkable achievement and particularly for the humorous and interesting way in which he has treated his subject, I should like to remark, also, that I think it is very good of the Staff Association to bring the clerical staff in on these occasions.

I believe that the good feeling to-day between the two sides of the house is stronger than it has ever been, and mutual participation in this way reinforces that happy situation.

Mr. Manley's paper shows him to be a remarkable combination of historian, naval architect as an amateur, and also something of the business efficiency expert.

On page 2 he refers to the fact that in the early days there was no compulsory time for retirement. As long as one had one's health and strength, one stayed on.

This reminds me of the occasion when Lloyd's Register was asked to take part in the Lord Mayor's Show and we had in this office many ancients, including J. F. Hill and his most venerable beard. The suggestion was put forward that we could do no better than engage a horse-drawn vehicle, manning it with our numerous veterans and having J. F. Hill showing a placard headed Lloyd's Register of Shipping, with the caption "Join Our Staff and Live for Ever".

The photographs of the football teams remind me in particular of T. Morris, who came to the Society as an expert on ferro-concrete and was certainly a "character".

I remember two stories about him. One is that as a member of the Society's cricket team he was travelling by train with the team to the ground where they were to play. *En route*, Morris's eye caught that of a very likely-looking young lady. The exchange of glances was apparently mutually satisfactory, and on the lady preparing to alight at an intermediate station, Morris did likewise remarking "Goodbye—you'll see me on Monday". We played one short.

Habitually, on meeting somebody new in his peregrinations around the office, he would buttonhole the individual and demand "Do you like your work?"—he got some extraordinary replies!

It also occurs to me in connection with this match and Mr. Manley's place in the photograph, that he must have enjoyed spending 90 minutes doing his best to get the ball into the Surveyors' goal, knowing that his life is otherwise devoted to keeping it out!

I have no more to say except that page 12 deals with the Society's part in the use of aluminium alloy and with concrete for ship construction. Page 13 deals, at length, with electric welding in shipbuilding. "Fragments" on page 15 which follows so soon after might seem, at first glance, rather a melancholy ending.

Mr. N. BETTS

This paper, to me, is both interesting and instructive. It must have meant a lot of research work and overtime by the Author, and I think we are very much indebted to him.

His notes on the ship records and the additional data they now have to keep will be of interest to all, and particularly the workings of the Technical Committee, of which I think I previously knew nothing. The Author has been associated with the Technical Committee for close on 30 years so is fully qualified to speak on this subject.

When I joined the Society Mr. Manley was in the army and, so far as I can recollect, Ship Department consisted of Mr. Harwood, Mr. Nettleton, Mr. Dollery, one or two juniors and about two lady typists.

As you have heard, Mr. Harwood was a fearsome kind of man to a junior and one whom we all approached with fear and trembling. He literally snapped at us, invariably saying "wait".

On one occasion he evidently mistook me for a messenger. I had to go up there with a message and as I entered the room Mr. Harwood snapped at me "wait". I stood petrified, and there I stayed until he realised I wasn't a messenger. His second-in-command, Nettleton, spent his time grumbling about his chief. The third man, Dollery, grumbled about them both. He was an unusual character, and a fanatic about cricket, although I believe he had never played the game.

When Mr. Manley returned from the Army, I remember I thought that he was such a "big shot", but I very soon found him most helpful.

The Author mentions Mr. Fowling. I recall being sent to M Department to take shorthand and Mr. Fowling started to dictate some technical endorsement. I couldn't understand a word and after a few moments I plucked up courage to tell him so. To my amazement, he produced a sheet of paper and started to make a rough sketch of explanation. I very much appreciated this and have never forgotten it. I feel sure the Technical Staff can always be relied upon to give explanations to juniors if they are asked to do so. Nearly all the other names mentioned are familiar and bring back memories of small incidents. Mr. Jordan has referred to Mr. Turner Morris who looked after plans for concrete ships. He obviously thought that his inside was made of the same material because at the first Cricket Club Dinner I attended I have a vivid recollection of Turner Morris being "sunk" before the dinner was half-way through.

Mr. Jordan also mentioned Mr. Ives. I once had the pleasure of taking down from Mr. Ives, and I cannot understand, to this day, why he didn't speak in every-day English. His language was almost impossible to understand. His favourite expression when referring to our agreement with the Registro Italiano was that they were "protagonists of the accord".

My main associations were, of course, with the outdoor staff and on the ship side it is interesting to recall that when I first joined L.R., David Nicholas was the Principal Surveyor. His son, now at Southampton, was subsequently on the London Staff, and now we have the third generation in the Freeboard Department.

It seems to me that the Ship Department is stealing all the thunder with this paper, and perhaps the Staff Association could persuade someone to write a somewhat similar paper dealing with the engineering side alone.

Mr. INGRAM

I should like to add my congratulations to the Author on an interesting paper. The historical part brought back memories of my early days in Lloyd's Register.

As the Author says, discipline was very strict in those days and his remarks about smoking reminded me of a story.

It was nearly 5 o'clock and he took out his tobacco and pipe which he carefully filled; with a glance at the clock, he struck a match. Immediately Mr. Harwood rapped out "May I remind you that smoking is not allowed until 5 o'clock?" The clock immediately replied by striking five.

Although I have been in the Department for so long, I have not been involved in the Author's additional work as Clerk to the Technical Committee.

I have noticed that, as the date of the Technical Committee or Panel Meeting approaches, the tempo of the work rises to a crescendo. All normal jobs have to take second place and all available staff is concentrated on getting the work ready. If someone has the temerity to make an alteration after all the reams of typing, checking and re-checking have been done, one can feel, if not hear, the words which are going through the ladies' minds, and I fear for the safety of the offender if he shows himself.

Somehow, the job seems to get done—by what means I never cease to wonder. Through it all, the Author seems to be unhurried and unruffled.

It may be of interest to know that the Ship Department remained in Mr. Ferguson's present room from 1901 to 1950. Since then, we have moved four times and the Staff has increased fourfold, which gives some idea of the expansion of the work.

I once heard that to be a good speaker one should stand up, speak up and shut up. I did the first with some difficulty, I hope I have done the second and I will now, with pleasure, do the third.

AUTHOR'S REPLY

Mr. Murray's remarks, and his personal reminiscences of earlier days, are most interesting. It has always been a pleasure to work with him, and to have the benefit of the help and advice he is ever ready to give.

I can assure Mr. Fowler that his earlier experience in the Engineering Department undoubtedly widened his knowledge and has proved of much use during his work in Ship.

Mrs. Tripp wonders how the men got on without lady assistants in the earlier days. Well, in the first place, it was much quieter in the office in those days; and secondly, the young men were able to devote themselves entirely to their work! Apart from that, I do not know what we would do without the ladies nowadays—they are a great help to us.

Mr. Bates mentions my quotation from the writings of Sir Walter Raleigh, whose work certainly repays study. He was at least a century before his time, and it is indeed amazing to look back on those early records and to find how much was known about certain general principles which still operate to-day. The reason why there are only nine Surveyors in the photograph of the football match is not that suggested by Mr. Bates; two of the Surveyors had to leave early to catch their train, and could not stop for the photographer. I hesitate to give the result of the match in goals scored, but it was not won by the Surveyors' team. I enjoyed his reminiscences about the use of iron in shipbuilding during the early 1870's; the quality of the material certainly improved in later days, and iron ships were built right up to World War I.

I thank Mr. Jordan and Mr. Norman Betts for their contributions and their interesting early recollections, which brought back many memories—they are two very old-standing colleagues of mine, and during our long service together we have seen a lot of changes in the Society.

Mr. Ingram's remarks are appreciated and I have a very vivid memory of the smoking incident which he describes.

Mr. Buchanan feels dated by the information given in the paper, but appears to date *me* to 1834 and that, of course, I cannot accept. As regards the technical problems, old and new, it is of course true that many entirely new matters arise. At the same time, there are many problems which have been studied in principle in earlier days, some instances of which are given in the paper, and I think that the two statements can stand side by side. It is true that individual electrodes were first entered in the Approved List of 1933, and I well remember all the work put in by Mr. W. Thomson and Mr. Buchanan in framing that list. The first Approved List, published in 1920, contained the names of electric welding processes which included electrodes, but it was not until coated electrodes were developed that these were included individually. I well remember the incident about Mr. Potts' handwriting—the statement which I reproduced from his notes commenced with the words "We are dead here to-day . . . . " and caused a great deal of fun in Headquarters.

I enjoyed Mr. van der Weel's remarks delivered in his usual inimitable way—it always gives us great pleasure when he visits London. I was particularly interested in his description of the career of Mr. Leeuwenburg, whom I knew for many years as one of our outstanding outport Principals.

Once again, I thank all contributors to the discussion, and for their encouraging remarks.

Printed by Lloyd's Register of Shipping at Garrett House, Manor Royal, Crawley, Sussex, England

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Lloyd's Register Staff Association

Session 1958 - 59

Paper No. 4

NOTES ON EDIBLE OIL QUANTITY SURVEYS

by

V. L. KILGOUR

LLOYD'S REGISTER OF SHIPPING

71, Fenchurch Street, LONDON, E.C.3

Notes on Edible Oil Quantity Surveys

By V. L. Kilgour

The Surveyor posted abroad to the East may find himself confronted with a request for a "Quantity Certificate" to give the amount of edible oil loaded into a ship's deep tanks. The survey itself is a comparatively simple matter, and most Surveyors will have an idea of how it should be conducted. There are, however, a number of points to watch and it is hoped that these notes on the subject will be of some use to colleagues without previous experience, who find themselves called in for this type of survey.

This does not purport to be a scientific paper, edible oil surveys are largely a very unscientific process, and as those who have partaken of their joys will bear out, can occupy a great deal of time and patience. The methods outlined herein are rough, but nevertheless practical. They do not pretend to be anything but attempts at reaching a reliable answer from what may often be unreliable data.

The conditions described refer to the port of Madras. In Madras, as elsewhere in India, it is the practice for the Society's Surveyors to be requested to certify the quantity of bulk edible oil loaded into a ship's deep tanks. It is not always possible to refer to accurately calibrated shore tanks for the result, and sometimes controversy arises regarding the amount placed aboard. In such cases a great deal of tact and diplomacy is required to keep the interested parties happy. The Society's reputation for impartiality is such, however, that there are cases on record where a family concern has asked for as many as 90 copies of certificates, and surely confidence so placed is convincing evidence of the appreciation felt for our services.

Quantity Certificates are required by the shipowners' agents as evidence that the oil was placed aboard, and the shipper often requires them for production at a bank in order that a letter of credit may be obtained. The amount allowed by the bank is normally about 98 per cent of the value of the certified load, the final adjustment being made at the port of discharge.

The refined and processed oils are transported to the loading point in clean containers which may be either tank lorries or steel drums, and loaded either direct into the ship's tanks or into calibrated shore tanks, where the amount can be easily measured, and thence by pipeline to the ship. The method used depends, to a large degree, upon the type of oil, it being a desirable practice to keep the shore tanks for the liquid most commonly exported, and thus reduce the possibility of contamination.

Contamination of an oil may take place either at the factory or subsequently by adulteration with another oil, and the importer in Europe is most particular in insisting upon careful tests being made before despatch and after receipt. The allowable amount of adulteration is very low, most oils in admixture can be detected quite easily even in very small quantities, and it is the duty of the Surveyor to ensure that when shore tanks are being used their pipelines are clean.

There are three methods of loading the oil:—

(1) From calibrated shore tanks

(2) From tank lorries

(3) From drums

Shore tanks. In the first method the oil is transported by bullock cart in 40-gallon drums. Upon arrival at the tank farm it is decanted into a long trough, which drains into a common sump, from where it is pumped into the desired tank.

An ullage is taken of the oil upon completion, and from tables supplied by the authorities the quantity of the oil can be determined. Samples may be taken at this stage if called for by the shipper.

One of the difficulties experienced when using shore tanks for quantity assessment is that invariably there is only a short period allowed between the filling of the tank and the taking of the ullage, as the shippers are anxious to get it on board and re-load the tank. If such is the case an erroneous result is bound to be obtained due to the air which has become entrapped in the oil in the form of fine bubbles not being given sufficient time to rise, and in consequence the bulk of the oil is increased.

A settling of as much as 2 in. has been observed by the Author and as this represented approximately $2\frac{1}{2}$ tons it will be apparent that it is advisable, whenever possible, to allow a reasonable time for settlement to take place after filling. About 12 hours should normally be sufficient, but this period will vary with the type of oil.

Tank lorries. Using this method the tank lorries are loaded at the factory, weighed entering and leaving the dock area and after making allowance for the petrol consumed, a fairly accurate estimate of the quantity placed on board can be obtained.

The lorry is either coupled to the ship's pipeline and oil pumped aboard direct, or else run into a trough on the quayside and pumped aboard by an independent pump.

From drums. In the third method the oil is emptied from drums into open troughs and then pumped aboard, the 40-gallon drums being weighed before and after emptying.

The above methods, however, are not without their drawbacks, and it must be kept in mind that, in the first, the quantity certified is in the shore tank and not in the ship's tank. This was borne home recently when 20 tons of molasses were pumped to a tanker alongside, but nothing came out at the other end. This same tanker took aboard a total of 3,456 tons, and it is estimated that the total losses, including the amount left in the drums, spillage and leakage during storage, amounted to approximately 250 tons.

The second method is open to question if the tank lorries are not placed correctly on the weighing platform or are influenced by wind pressure.

In the third type of loading the quantity is assessed by what is known as "Weighment"; here all the drums or, at the instance of the shipper, only 25 per cent of them, are weighed before and after emptying. These drums are usually in a pretty bad state of repair and are often badly battered and their interiors heavily encrusted.

The snag in this case is the difficulty in keeping a check on native labour on the quayside, and there is a distinct possibility of the drums getting mixed up and weighed twice or thrice or perhaps not weighed at all. A case in point was a ship in which the Society's Surveyor's amount was 4 tons less than the weighment, this was represented by 4 in. on the ship's ullage scales. A later case was, according to the shipper, 25 tons short, and it had to be pointed out that this was equal to an error in ullage of about 18 in. No doubt people at home will find it hard to believe that the shipper was not aware of the rough quantity being shipped, but it seems to be the case when the oil is purchased from many hundreds of small crushers scattered in villages far and wide and transported over 100 miles in leaky drums by bullock cart or lorry.

In view of the value of the cargo it is surprising that no accurate method of measuring the quantity of oil shipped has been evolved. The best results at present are obtained when:—

(1) The oil is placed in accurately calibrated shore tanks and allowed to settle;

(2) The oil is loaded directly aboard from tank lorries which are weighed entering and leaving the dock area.

The method that a Surveyor to this Society will be interested in is, naturally, from calibrated tanks either ashore or aboard ship. Obviously he cannot undertake a weighment survey due to time and the number of staff that are involved.

Of the two, the estimation from shore tanks is the simpler, the ship's tanks often being something of an "unknown quantity", and as the survey is carried out in a similar manner in each case it is proposed to deal only with the latter.

The survey can be divided into three headings, Ullaging, Sampling and Calculation, and to tackle this type of work the Surveyor will require to be equipped with a "Sampling Kit" containing the following:—

1 — Sampling rig (Figs. 2 and 3)

1 — Set of 3 hydrometers (·85/1·0)

1 — Glass measuring cylinder

1 — Thermometer in brass case

A small metal tundish

Sufficient 8 oz. bottles for the number of samples required, together with labels and corks.

Requests for Quantity Surveys are usually received well in advance, whilst the tank is still being cleaned. As the Surveyor will very likely be attending the ship for the purpose of examining the tank for cleanliness, he would be well advised to make sure that the ship's tables are, in fact, aboard and that the tables produced do refer to that particular tank. He should be sure that the ullages, if shown, are taken from the underside of the tank lid, and not from an air pipe at side, or from a sounding pipe at the forward or after ends of the tank. At the same time, it should be ascertained if the table gives allowances for trim and list, or if it is merely drawn up for even keel soundings or ullages.

These precautions may appear to be elementary, but it is too late once the tank is loaded to try to calculate from tables which give insufficient or inaccurate information.

In the odd case where no tables are available, it may be necessary to make a volumetric assessment of the tank capacity, taking into account the volume occupied by heating coils, angles, and beams. This has only occurred once in the Author's experience, and fortunately the tanks concerned were of a regular shape, one being rectangular, and the other "L" shaped, tapering at the entrance trunking.

It is rare to find a set of tables aboard which provide for ullages at the tank lid, it being usual to find a sounding scale with the sounding pipe positioned at the forward end or the after end of the tank, at the main deck level. The taking of soundings should be avoided wherever possible. Soundings taken at sounding pipes are bound to produce inaccuracies due to the slackening of the tape when the weight touches bottom, which gives an inaccuracy of not less than ¾ in. when working from deck level. Should it be thought better to take three or four dips with the intention of reaching a mean sounding, each raising and lowering of the tape coats the inside of the pipe with oil which is transferred to the tape at each dip after the initial one. Soundings taken at air or

sounding pipes positioned at the ship's side give greater inaccuracy due to the curve of the pipe. Soundings are messy and should be avoided.

It is the Author's opinion that in all cases where soundings are given they should be converted into ullages. As it is reasonable to assume that the tank top lies parallel with the keel plate, it follows that if ullages are taken at a convenient point, such as the tank lid manhole, corrected for the trim of the ship to give an ullage for conditions of even keel, then the sounding tables for even keel conditions can be referred to.

Putting it simply: —

Even keel sounding of tank when full (from scale) — Ullage corrected for trim

=Sounding of liquid in tank

Should the tank top slope fore and aft or have a camber, then that is another point to be borne in mind. In cases where the sounding pipes follow the ship's side, and especially so when the tanks are situated forward, as in the Liberty class of ship, the angle of inclination of the pipe to the vertical may have to be taken into account, it being known beforehand the amount of oil to be loaded, and therefore its approximate level.

In cases such as the above it is a good practice to enter the tank prior to loading and to make a rough sketch giving dimensions which can be referred to later, as shown in Fig. 1. It should be observed also at this time whether there are any bilge wells that have been sealed off, as these are usually included in tank capacities, and must be allowed for.

Upon the completion of the loading of the tank it is well to insist upon at least 12 hours before commencing the survey, in order that the contents may settle and the entrapped air rise.

Whenever possible, it is preferable that the ship has no list, and it is usual to give the Chief Officer prior notice of this requirement so that he can make the necessary arrangements. The list should be checked prior to the taking of the ullages. Most ships have a list indicator and the binnacle is always provided with a spirit arc. Often the two do not agree, but there is always someone aboard who checked one or the other at the last drydocking, and the indicator at the end of the Mate's bunk is invariably claimed to be correct.

A note should be made of the length of the ship at the waterline at that particular trim, and a note of the trim made. If the length is not readily available it can be scaled off the ship's general arrangement plan.

Ullaging. Ullages should always be taken from the underside of a tank lid. However obvious this statement may be, often tanks are found to have been calibrated for ullages taken from the top of an ullage port, and it is well to be aware of this when checking the height at the ullage port (*see* Fig. 1).

An accurate steel sounding tape should be used for ullages, and as ships are usually equipped with good quality tapes, it is often convenient to use the one aboard and thus prevent any argument that may arise later. Care should be taken when ullaging that no froth is present on the liquid surface, which would give a false ullage.

Samples. Samples are normally taken from the top, middle and bottom of the tank, although some shippers may call for a mixed sample or even samples taken at intervals of 3 ft.

Suitable sampling rigs are shown in Figs. 2 and 3. Fig. 2 shows the type used at Calcutta, and consists of an aluminium one-pint milk-can suitably weighted. The lid is closed and the can lowered to the desired level, and then opened by jerking the lid cord. Its advantages are ease of cleaning and robustness. Its disadvantage is that the cords become tangled.

Fig. 3 shows an alternative type used at Madras, consisting of a weighted cage into which a narrow-necked 16 oz. bottle can be clipped. Although it may appear that the bottle will begin to fill before reaching the desired level, this is not so, for when lowered quickly enough, no oil enters until it becomes stationary. Its advantage is ease of handling, but its disadvantages are difficulty in cleaning the bottle, and its fragility, unless carefully handled.

Samples of oil taken by either of these methods should be immediately poured into the 8 oz. sample bottles. It is a good practice to mark the corks of these bottles for purposes of identification, leaving the labelling until later in order that the labels may be kept clean.

The labels should bear the following information: —

(*a*) Name of ship.
(*b*) Date and name of port.
(*c*) Position and number of tank.
(*d*) Whether sample is from the top, middle or bottom.
(*e*) The Surveyor's signature.

The bottles when labelled should have their corks cut off flush, their necks sealed with wax, and the impression of the Surveyor's stamp made in the wax whilst still hot. A good way of doing this is to melt a tinful of sealing wax on the galley stove, and dip the necks of the bottles in it.

Temperatures. Whilst sampling is in progress it is advisable to take the temperature at each level. This can be done either by taking the temperature of the sample immediately, or by lowering a brass cased thermometer to the required level. Temperatures can vary a great deal between the top and bottom and a difference of as much as 10° F. has been observed. This point will be appreciated when dealing with specific gravities.

Specific Gravities. The weight of the oil cannot be calculated without its specific gravity being known. For this reason the sampling kit usually

contains a set of hydrometers which will measure specific gravities ranging from ·85 to 1·0 and a glass cylinder for containing the oil sample.

The specific gravities of the oil at each level can be obtained separately and their mean taken for the weight calculation. The Author has found that it is quicker (speed is an advantage in a hold at a temperature of 110° F.) and just as accurate to mix equal quantities of the samples from each level and obtain a mean specific gravity by direct hydrometer reading, the temperature being taken at the same time.

Sometimes a request will be received to submit a sample to a laboratory who will supply the specific gravity themselves. In this case the specific gravity normally given is referred to water at 60° F. or 15° C. and it will require to be corrected for temperature. Over the range of temperatures at which oils are normally heated the density maintains a substantially linear variation with temperature, decreasing approximately 0·000355 for each increment of 1° F. or about 0·00064 for each 1° C. and these figures will be found of sufficient accuracy for most edible oils.

Specific gravity can also be calculated from the following empirical formula, provided sufficient information is available, and although this method can serve as a useful check, it cannot be claimed to be accurate for all oils.

Specific gravity (at 15° C.) $= 0{\cdot}8475 + (0{\cdot}00031 \times \text{Saponification value}) + (0{\cdot}00014 \times \text{Iodine value})$

Iodine and Saponification values for some edible oils are shown in Table 1.

Certificates. These should be reported upon a Report 10 and are worded in the usual manner with the following statement included for ship's tanks: "for the purpose of ascertaining without prejudice the quantity of..............................oil loaded into the vessel's No.........................deep tanks, as calculated from the ship's calibration scales" and "without prejudice the quantity of ....oil pumped to the vessel's ....deep tanks from the Nos. ....shore tanks of the.................... Port Trust" in the case of shore tanks (*see* Appendices A and B).

If the oil is loaded from shore tanks and they have been examined for cleanliness prior to being filled, a statement to this effect should be included.

The calculation should then be given with any necessary information.

As already mentioned, some ships (unfortunately comparatively few) are equipped with ullage tables, for ullages taken at the tank lid, ullage port or manhole, and these tables may also give corrections for trim and list. If so, it is a simple matter to obtain the quantity in the tanks by interpolation, correcting for specific gravity, bearing in mind that the tank may be calibrated for tons of sea water or oil at 38 cubic feet/ton. In the case where the tanks are calibrated for conditions of even keel, the following method of correcting for trim can be adopted, which will give a trim correction with no greater degree of error than is incurred by the human element whilst taking ullages.

$$\text{Ullage correction} = \frac{t \times d}{L}$$

where t = trim by stern or head

d = distance from centre of area of liquid surface to ullage port.

L = length of ship on waterline.

(*see* Fig. 4).

It should be remembered that when the ship trims by the stern the figure obtained should be added for ullages taken abaft the centre of area of the free surface, and subtracted for those forward of it, and vice versa when trimming by the head.

Corrections for list can be made in a similar manner by taking measurements of the height of deck from water level on the port and starboard sides, or better still, if there is a reliable list indicator aboard, by the use of simple trigonometry.

A reference should be made that samples were taken, sealed and handed to a ship's officer, and finally there should be a clear statement of the quantity either "as calculated from the ship's calibration scales" or "pumped to the ship's ....deep tanks from the.................. shore tanks" followed by the Surveyor's signature.

Conclusion. In concluding, it must be stressed that it is not claimed that the method of assessment discussed here gives results as accurate as those obtained using shore tanks or tank lorries and weighing, it being merely the purpose of these notes to describe the method undertaken to give the shipper some check of the quantity of oil taken aboard.

Oddly enough, the other authorities concerned usually welcome a check on their results, and considering that ships' scales are not usually drawn up with any great degree of accuracy, quite good results have been obtained, and the writer can recall pleasant arguments over weight differences of 25 to 50 lb. Results such as these on cargoes of 100 tons or more are encouraging, and lead one to believe that some shipyards take more care over their calibration scales than others.

The value of this type of survey would be enhanced if ships could be provided with accurate tables, which are arranged for readings of ullages, and whose readings do not jump in 6 in. divisions giving quantities to the nearest ton. This is a matter for the shipbuilders but, with the increased carriage of bulk edible oil cargoes and the interest at present being taken in the proper design of deep tanks for this purpose, there is reason to hope that these desirable features will be given the consideration that, in the Author's opinion, they fully deserve.

TABLE I

SOME TYPICAL PROPERTIES OF EDIBLE OILS

	Groundnut	*Cottonseed*	*Nigerseed*	*Castor Seed*
Specific Gravity at 15·5° C.	0·917/0·919	0·916 to 0·930	0·924 to 0·927	0·958 to 0·968
Saponification value	185 to 192	191 to 198	189 to 193	177 to 187
Iodine number	83 to 95	112 to 116	126 to 134	82 to 90
Approximate value sterling/ton	£137/-	semi-refined £120/-	£123/-	£146/- to £153/-

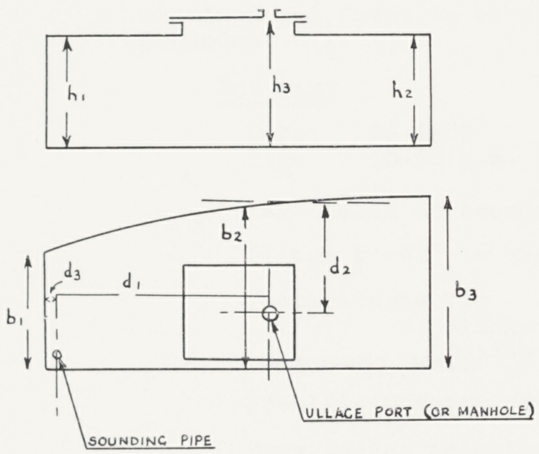

FIGURE 1

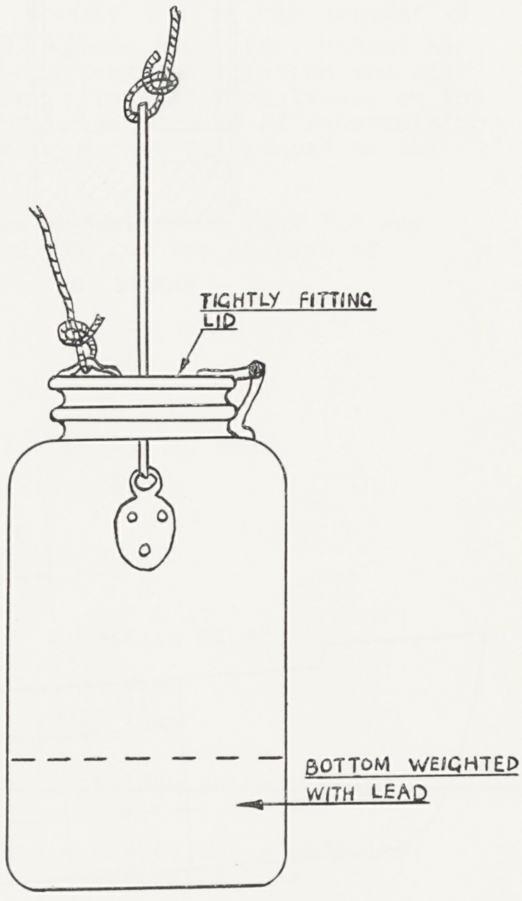

FIGURE 2

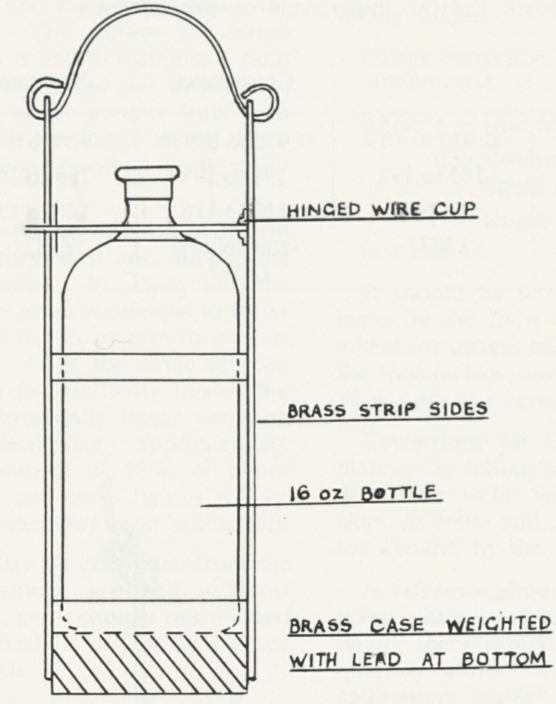

FIGURE 3

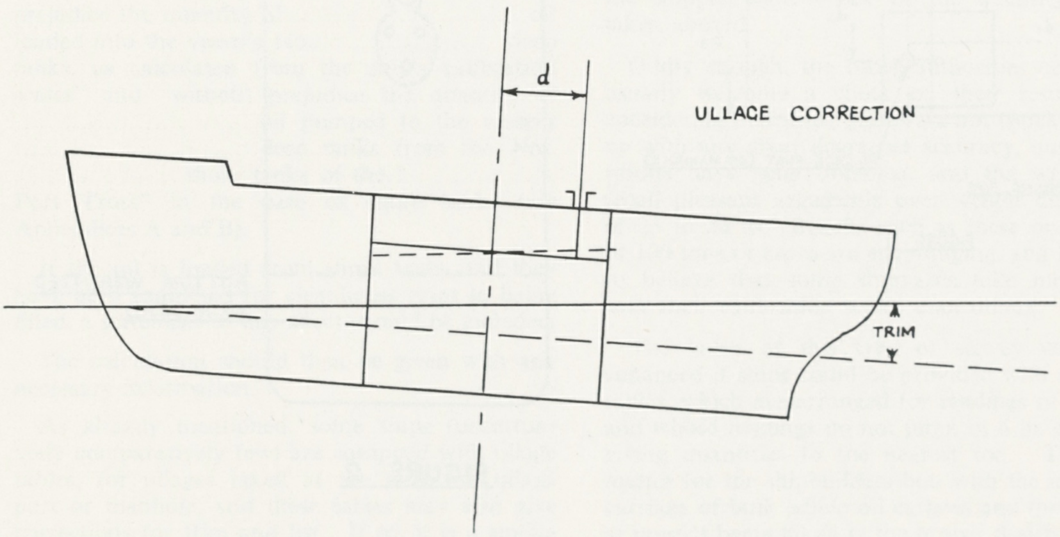

FIGURE 4

SHORE TANK

Appendix A

LLOYD'S REGISTER OF SHIPPING

Port BHOWANI

26th April 1958.

This is to Certify that

J. S. OAP

the undersigned Surveyor to this Society did at the request of the Owner's representative Messrs. Agents & Co. Ltd. attend at the Bhowani Port Trust vegetable oil tank installation and also the vessel s.s. "GOODSHIP" 7258 tons gross of Port Isaac, on the 24th April 1958 and subsequently for the purpose of ascertaining without prejudice the quantity of Groundnut Oil pumped to the vessel's port deep tank.

Prior to being used the shore installation tank "C" was examined and found to be clean and fit for the storage of Groundnut Oil.

"C" TANK

Date 25-4-58
Time 10-00 a.m.

Ullage taken at sounding point in top of tank

Ullage 5'-6$\frac{7}{8}$" = Sounding 15'-3$\frac{1}{8}$"

Temperatures Top 35.5°C
Middle 34.5°C
Bottom 33.5°C

Specific Gravity of oil = 0.9054 at 34.5°C

From tables Weight of oil in "C" tank
= 59241.125 x 0.9054 lbs.
= 536369.145 lbs.

Collected from "C" tank and pipelines on completion of pumping = 1839 lbs.

Therefore oil pumped to ship = 536369.145 - 1839 lbs.
= 238.62936 tons

(Rpt. 10) 100m,3,58 T. (MADE AND PRINTED IN ENGLAND)

The following particulars were noted on the ship after completion of loading.

Draught	forward	15'-0"
	aft	17'-6"
		1^{o} to port

Ullages on ship taken at manhole from underside of tank lid

PORT DEEP TANK

Forward	1'-0$\frac{3}{4}$"
Aft	1'-0$\frac{1}{4}$"
Port	1'-0$\frac{1}{2}$"
Starboard	1'-0.9/16"

I hereby certify that the quantity of Groundnut Oil pumped to the vessel from the "C" Tank of the Bhowani Port Trust Installation is two hundred and thirty eight point six, two, nine long tons (238.629 tons)

(signed) J.S. OAP

Surveyor to Lloyd's Register of Shipping.

SHIP'S TANK

LLOYD'S REGISTER OF SHIPPING

Port BHOWANI

26th April 1958.

This is to Certify that

J. S. OAP

the undersigned Surveyor to this Society did at the request of the Owner's representatives, Messrs. Agent & Co. Ltd. attend on board the s.s. "GOODSHIP", 7258 tons gross of Port Isaac, whilst the vessel lay afloat at the Centre Berth, West Quay, Bhowani on the 25th April 1958 and subsequently for the purpose of ascertaining without prejudice the quantity of Groundnut Oil loaded into the vessel's No.1 Port deep tank.

Date	25-4-58
Time	9-45 p.m.
Draught Forward	15'-0"
Aft	20'-0"
List	Nil
Length of ship at waterline	400 ft.

Trim correction $= \frac{60}{400}$ ins/ft.

$= 0.15$ ins/ft.

Distance from Ullage point to Centre of area of free surface = 6'-0"

From examination of the ship's sounding tables it was found that the volume of the tank lid coaming was not included in the tank capacity, and that to obtain an ullage the height of the coaming must be subtracted from the ullage taken.

Height of tank coaming = 12"

No. 1 Port Deep Tank

All ullages measured from underside of tank lid at manhole.

Forward	2'-0"	Mean 2'-0"	Temperatures Top	33°C
Aft	1'-11$\frac{3}{4}$"		Middle	31°C
Port	2'-0$\frac{1}{8}$"		Bottom	29°C
Starboard	2'-0$\frac{1}{8}$"			

Specific Gravity of oil cargo = 0.9055 at 31°C

(Rpt. 10) 100m,3,58 T. (MADE AND PRINTED IN ENGLAND)

Corrected Ullage for even keel) = 2'-0" + 6'-0" x 0.15
conditions) = 2'-0" + 0.9"
= 2'-0.9"

Sounding of tank when full = 18'-0"
(from ship's tables)

Therefore sounding of oil for even keel conditions

= Full sounding - (corrected ullage - Height of coaming)
= 18'-0" - (2'-0.9" - 1'-0")
= 16'-11.1"

Oil in tank at this sounding from ship's tables at 38 cu.ft. per ton (Interpolating) = 100 tons.

Correcting for Specific Gravity taking water as 62.2882 lbs/cu.ft.

$$\text{Oil in tank} = \frac{100 \times 38 \times 62.2882 \times 0.9055}{2240}$$

$$= 95.63 \text{ long tons.}$$

Samples A sample of the oil taken from the top, middle and bottom of the tank sealed and handed over to the ship's Chief Officer.

I hereby certify that the quantity of Groundnut Oil loaded into the vessel's No. 1 Port deep tank as calculated from the ship's calibration scales is: Ninety five point six three long tons (95.63 tons)

(signed) J.S. OAP

Surveyor to Lloyd's Register of Shipping.

Printed by Lloyd's Register of Shipping at Garrett House, Manor Royal, Crawley, Sussex, England

FOR PRIVATE CIRCULATION AMONGST THE STAFF ONLY

Lloyd's Register Staff Association

Session 1958-59

Paper No. 4

Discussion

on

Mr. V. L. Kilgour's Paper

NOTES ON EDIBLE OIL QUANTITY SURVEYS

LLOYD'S REGISTER OF SHIPPING

71, Fenchurch Street, LONDON, E.C.3

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Discussion on

Mr. V. L. Kilgour's Paper

Notes on Edible Oil Quantity Surveys

MEETING IN LONDON

16th DECEMBER, 1958

Mr. J. WORMALD

At these discussions there usually are, or should be, representatives of two schools of thought, those to whom the paper is intended to be helpful in the future and who should not hesitate to seek further enlightenment from the Writer of the paper, and those who have already had some experience of the subject under discussion, and who may be able to add to the value of the paper by airing their own views, even though they don't always agree with those of the Writer.

I am one of those who have already dabbled in edible oils; one of those for whom the sickly stench of hot vegetable oil and the ceaseless chatter of sweating Asians has often provided an inescapable background to the solution of problems similar to those Mr. Kilgour has so ably elucidated for us today. I am very pleased to be among the first to thank Mr. Kilgour for the paper which he has written on the subject of edible oil quantity surveys.

It is my honest opinion that Mr. Kilgour has left us few loopholes for discussion of the practical aspects of his subject, but I do propose to refer to one or two points connected with policy which I am quite prepared to admit now are more or less pedantic!

Mr. Kilgour says on page 1 "It is the duty of the Surveyor to ensure that when shorelines are being used, their pipelines are clean" and again on page 4 "If the oil is loaded from shore tanks and they have been examined for cleanliness prior to being filled, a statement to this effect should be included" in the certificate.

It is acknowledged that practices and conditions vary from port to port, but one should not overlook the fact that Surveyors have only been authorised by the Committee (1) to certify that the tanks in the ship are fit to receive and carry the oil, and (2) to assess the quantity of the oil shipped and to sample it when it has been shipped. It is admitted that the precautions to which Mr. Kilgour has referred are necessary, but is it right that a Ship Surveyor should give interested parties the impression that the Society is, in any way, responsible for facilities over which the Surveyor has no ultimate control?

Mr. Kilgour has also referred to the difficulties of getting correct ullages when oil is poured into shore tanks and again later when it is transferred to ships' tanks, and in the paper has said it is well to insist on 12 hours' delay before starting the survey. The Surveyor cannot expect always to be able to allow 12 or more hours to elapse between loading and taking ullages, and I would suggest that the best advice to give is more or less what Mr. Kilgour has said—to allow as much time as possible to elapse, and make a note of the time, so that if there is any settling down there is a reasonable explanation at a later date in case of dispute.

The purpose of the quantity survey is to *assess* the amount of oil shipped within the limits of the time and means available. It has been stressed that the methods outlined in the paper are rough, but they are nevertheless practical, and I would like to ask Mr. Kilgour a couple of questions in connection with the taking of ullages.

1. Does Mr. Kilgour advocate the use of a sinker or a float at the end of the steel sounding tape?

2. Having considered all known possibilities of error, does Mr. Kilgour agree that it is unduly optimistic to expect corrected ullage readings to be within $\pm\frac{1}{8}$ in. of the true reading? If this figure is, in fact, achieved, then $\frac{1}{8}$ in. ullage in the case of the tank referred to in Appendix A, which is roughly an average size of deep tank, represents 0·16 tons of oil. Is it not out of harmony and very unwise to certify the tonnage of oil shipped to three places of decimals when the practical difficulties connected with ullage and capacity measurement indicate that even the second decimal place is doubtful? In the event of the Surveyor's figures being disputed, could not such a statement be a boomerang in the hands of a mathematically minded lawyer?

It is noted that ullages in both the given examples are measured at the four extremities of a manhole opening, presumably 16 in. $\times$ 12 in. or thereabouts—is this done because the underside of the tank readily provides a datum line? This appears to be an unnecessary refinement when a single reading taken at the middle of the opening, corrected if necessary for an improvised datum line, would suffice to give a reading within the $\frac{1}{8}$ in. range suggested previously. Incidentally, I think the ullage figures given in example B seem to indicate that the tank lid in way of the manhole door was buckled!

Previous literature on the subject of these cargoes recommends the provision of ullage or sighting holes at the four corners of the hatch-cover—readings taken at these four manholes will

give a wider variation between individual readings, and the average should be nearer the true reading, but, having taken the ullage correctly, the real answer to the problem of quantity assessment is as Mr. Kilgour suggests: Reliable calibration scales should be provided for every ship's tank intended for the carriage of these commodities; the tanks should be calibrated by positive methods; the work should be done and the calibration scales should be certified by "sworn measurers" or similarly qualified persons, and they should not be based on estimates of capacity as made in a shipbuilder's drawing office. Where certified scales are available and are used in assessing the quantity of oil shipped, an appropriately worded reference to the fact should be made in the certificates issued by the Surveyor.

A few years ago it was suggested that when plans for deep tanks were approved for carriage of edible oils, a memo should be sent to the shipbuilder and shipowner suggesting that it would be of benefit to them to provide calibration scales from the beginning, but the attitude of the Society at that time appeared to be that it would be interfering with owners if we were to take such action. There does not seem to be any logical reason why the Society could not word this advice in such a way that no owner could take offence. Have we not advised owners officially as to the amount of spare gear to be carried, how not to load shelter deck ships with large capacity deep tanks amidships, how to ballast tankers, without offending them or without making it a condition of classification?

In thanking Mr. Kilgour once again for this excellent paper, I think it is worthy of mention that he is officially on leave, and we ought to be all the more grateful to him for having come along in person to present his paper and to reply to our questions.

Mr. J. GUTHRIE

I feel very diffident about taking part in this discussion as my experience of vegetable oil tanks is limited to the shipment of chemically processed vegetable oils (oil foots) destined for the soap trade, and as the degree of cleanliness in the tanks for this type of oil is not too high and the cost of the oil quite low, the standards are different from those obtaining in the loading of edible oil. In the relatively few cases which have come under my survey, the information contained in the certificate was confined to draughts fore and aft and the ullages taken at the four corners of the oil tank hatchway. These were agreed by both the shipper and the chief officer and, it should be noted, were quantities which required no judgment and consequently admitted of no difference of opinion.

However, there are several points in the paper which struck me as being unusual, and I should like the Author's comments on some of them.

On the first page, column 2, it is claimed as the duty of the Surveyor to ensure that when shore tanks are used, their pipelines are clean. Does this mean dismantling the whole pipe system, or simply flushing them clean with water?

Also, on page 2, column 1, in describing the "weighment" system, the Author states that the oil drums are often battered and heavily incrusted inside. It is concluded these incrustations are deposits from the vegetable oil, but in a hot climate these would rapidly decompose and contaminate the liquid contents. Although this has nothing to do with the subject of the paper, it would be interesting to know how contamination from this source can be avoided.

With regard to specific gravity, surely this should be declared by the shipper or his agents; if not, who supplies the figures for saponification and iodine values? In any case, the difference in bulk between oil at 60° F. and the same oil at the loading temperature will not be more than 1 per cent so that the correction factor quoted to six places of decimals seems over-cautious, especially as the thermometer in use may read a couple of degrees out.

In dealing with the measurement of the oil on board, I feel the Author has rather overestimated the problem. With the vessel afloat, the free surface in a large tank is constantly moving, and when surface tension at the dip stick is taken into account, an ullage error of $\frac{1}{8}$ in. would pass unnoticed, and this might account for 2–3 cwt. Also, deep tanks are usually calibrated in the drawing office from ships' plans, and it is extremely doubtful if any shipyard will guarantee the accuracy of the scales to within less than one ton. Consequently, as his calculations must inevitably be based on data which are only accurate to round figures, it is not understood how any Surveyor can certify the quantity of oil in any tank to three places of decimals, or to a few pounds weight, as quoted in the sample certificates.

Finally, with regard to his remarks on the large number of certificate copies requested by some shippers, the Author has my whole-hearted sympathy, as many agents abroad seem to think in terms of certificates in bulk. My practice has always been to issue two copies free with each certificate or report and to charge one guinea for each additional copy. It is astonishing how the demand for copies falls off when a charge is made for them.

WRITTEN CONTRIBUTIONS

Mr. J. R. P. CONOLLY (Karachi)

This paper particularly interested me as it details the completion of a survey which I have frequently started by testing of the tanks prior to cleaning at another port for the carriage of edible oils.

I was surprised to learn, however, that the oil is sometimes run into open troughs before being pumped into either shore or ship tanks which have been scrupulously cleaned for its reception. If these troughs are placed on the quay I should think that the probability of contamination of the oil from a dust-laden atmosphere, possibly from a ship discharging or loading coal or ore nearby, is very great and some form of light portable cover would seem to be called for.

The Author also suggests that the oil should be allowed to settle for 12 hours before taking ullages. While I appreciate that there is a very good reason for this, it would appear to be impracticable in cases where the oil is the last or only cargo to be loaded at that port, as delaying the vessel for so long would not seem to be in the best interest of the owners. Perhaps some addition to the ullage of the order of 0·5 in. for every hour less than 12 that the oil is allowed to settle would give a satisfactory result, but the Author's comments on this suggestion would be appreciated.

Mr. H. NUTTER (Visakhapatnam)

First I would like to thank Mr. Kilgour for his informative paper. Having had a quantity survey "out of the blue", I know the trials of doing one for the first time, and the paper will be a help to Surveyors in a similar position.

The method of loading here is No. (3), and the quantity cannot be checked at the shore end without a staff. Even though the shipper's staff and Customs officials are checking the weighing, it is felt this is not very reliable, and some percentage has to be allowed for spillage.

Due to difficulties of cleaning, the sounding pipe is blanked off usually, so that a direct sounding cannot be taken. If there is time before the loading of cargo, the tank can be examined to compare an ullage sounding with the sounding pipe as suggested by Mr. Kilgour. This has not been possible here for various reasons, and great difficulty was found equating the calibrated soundings with ullages. Ullage measurements can be taken very accurately, and it is felt that more attention could be paid in the shipyard to the calibration of deep tanks, and ullage readings always given from an ullage plug, as well as soundings. Mr. Kilgour relates differences of only 25 to 50 lb., but as calibration of ship tanks is usually worked on loft offsets with percentage deductions for structure, we cannot hope for this accuracy using the ship calibrations.

The sampling bottle in which the lid is jerked open at the required depth was found unsatisfactory, due to the tangling of the cords when they become oil soaked. The open narrow-necked bottle was found to give complete satisfaction and is much quicker to use.

Mr. Kilgour refers to W.L. length at the particular trim, but this could be quite different from the length between draught marks, which should be used for trim correction.

The most important information given on the Rpt. 10 is the ullage reading, together with densities, temperatures and condition of trim and list. These readings are taken before discharge of cargo, and in case of dispute, these figures can be related with reasonable accuracy. The owner calls us in so that he can prove that he is delivering the quantity of oil that he took on board. The samples are there to verify the quality.

Mr. R. RENNIE (Vancouver)

Mr. Kilgour's paper describes in an interesting manner the method of dealing with vegetable oil loading surveys in Madras. This paper, studied with Mr. J. Wormald's classic paper, "Some Notes on Deep Tanks for Edible Oil and Similar Cargoes", should be most helpful to Surveyors called on to undertake such surveys for the first time. Mr. Kilgour is to be congratulated on his effort in writing up his experiences of one aspect of a Surveyor's duties so that it is on record to help others.

The British Standards Institution issues a number of Standard Specifications covering various edible oils, and copies of these should be available at loading ports.

In British Columbia we have carried out fish oil loading surveys for many years. Herring oil (described variously as Canadian Herring Oil or British Columbia Herring Oil) and whale oil are exported to Europe regularly, and varies from zero to as much as 10,000 tons each season. The quantity, of course, depends on the size of the catch, price, freight rates and Canadian domestic consumption. Pilchard oil was also exported at one time, but not recently. A quantity of tallow, possibly for soap, is exported but we have not been concerned with this cargo.

The commercial value of these oils depends on colour (in general the lighter coloured oils are more valuable), free fatty acid content, which is usually specified not to exceed 2 per cent, vitamin content, water and other impurities and unsaponifiable content. This latter may be specified as 2 per cent maximum and, in whale oil, is indicative of the presence of sperm oil. Sperm oil is obtained by rendering the carcase of the sperm whale including the blubber and head, and is generally unsaponifiable. The value of herring oil during the 1958 season is about $7\frac{1}{2}$ cents a lb., say 70 cents an Imperial gallon or $168.00 a ton. The ocean freight British Columbia to Europe is about $20.00 a ton. Whale oil is about $\frac{1}{4}$ to $\frac{1}{2}$ cent a lb. more.

Both herring oil and whale oil may be darkened in colour and contaminated and free acid content increased by overheating or by over-exposure to air. Whale oil solidifies or gells at 55° F. and herring oil at 50° F. These oils are liquid at 80° F. and a convenient discharge temperature is

85° F. They should not be heated beyond 95° F., so that careful attention to heating by steam coils is necessary.

In Vancouver we are spared much of the complications described by the Author, as loading is almost invariably direct from calibrated land storage tanks which are owned for the most part by the Port Authorities. These tanks have all been calibrated by the Society's Surveyors, as have some peak tanks and separate tanks on several local coasters. Occasionally oil is loaded from railway tank cars or from a few odd steel drums, but the quantities, in these cases, are obtained by weighing before and after loading.

The supervision of the loading and verification of the weight loaded is often carried out by the Surveyors, but the specific gravity is established and other sampling dealt with by a local chemical testing laboratory working directly for the Shippers. No attempt is made to establish the quantity loaded from the calibration charts of the ship's deep tanks as these are not considered sufficiently accurate. After loading, ullage readings, list, trim and temperatures are noted as described by Mr. Kilgour. Usually, here, loading takes place during the night hours and the ship may have to leave almost immediately after pumping finishes, and insufficient time is given for the oil to settle, but times are noted on the Certificate.

The quantity loaded is calculated from ullage readings from the land storage tanks corrected to 60° F. from actual mean temperature taken from readings of top, centre and bottom of tanks and converted to weight from the specific gravity figure supplied by the chemical laboratory. We use an expansion factor for fish oil of ·000404 U.S. gallons per degree Fahrenheit. Before loading commences the pumps, piping and flexible hoses are checked full of oil so that after loading is complete, and if these are left still full, then no correction for this oil is required. If the land tanks are emptied, and usually all but the last one will be, then the weight from each is readily obtained. An allowance must be made in the case of each tank for residue on sides and bottom. We have estimates of residues noted for each tank based on $\frac{1}{8}$ in. thickness on sides and on bottom and the amount is then readily estimated. If the tanks are hand brushed after emptying, the residue is more easily obtained. The amount loaded should be agreed with the interested parties right away and, to reduce chance of complaint for shortage on arrival, it is sound policy to keep this in mind when estimating the amount loaded, the quantities in shore tanks and the residue, also to allow oil to settle as much as possible before taking ullages. I am fully in agreement with Mr. Kilgour regarding the superiority of ullage readings over soundings.

A check on the amount of air in suspension in fish oil was made here on one occasion. The oil was discharged from a ship's tank into a land storage tank about 9 ft. 5 in. diameter. The initial sounding was 14 ft. 8 in., temperature 86° F., quantity 24833·73 U.S. gallons. After 37·5 hours the sounding was 14 ft. 7$\frac{3}{16}$ in., temperature 77·3° F., quantity 24806·73 U.S. gallons, apparent loss 27 gallons = ·108 per cent. The experiment was continued for several days and it was concluded the amount of air in the oil after pumping from ship to shore tank was approximately ·1 per cent and settled fully after about 48 hours at temperatures of 70–80° F.

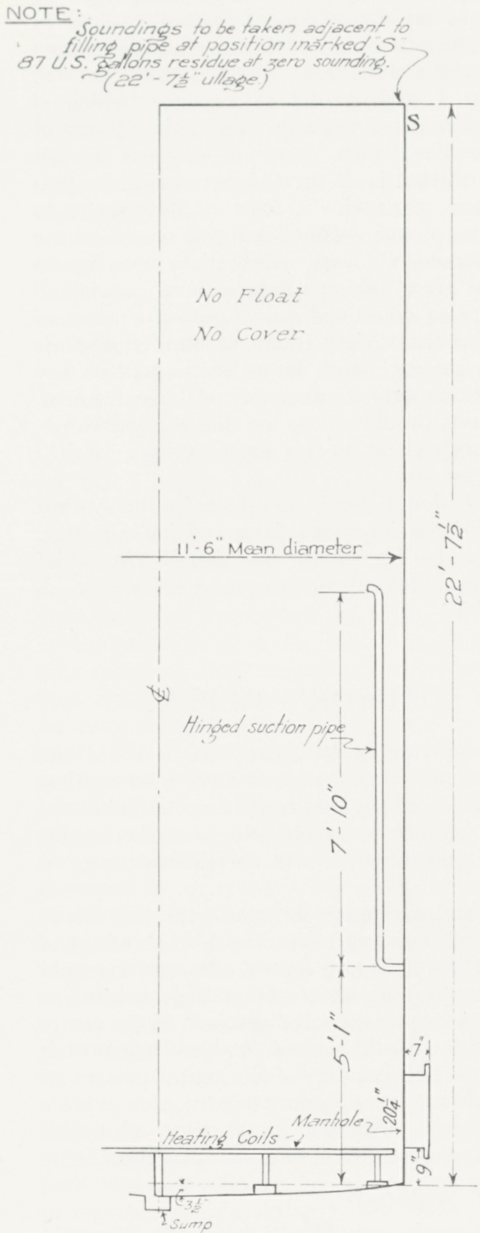
Great care is necessary in the calibration of storage tanks if established from direct measurement and calculation. The ideal method, of course, would be to calibrate by weighing in known quantities of liquid at the normal loading temperature. The lower foot or so should be done by weighing in, if possible, as this may include heating coils and supports and a conical bottom draining to a sump: the remainder may be measured. These tanks are usually cylindrical. The external circumference is obtained by "strapping" with a standardised steel tape at several points in each strake of plating. Several men are needed for this, to ensure the tape is level and taut. The mean circumference for each strake is obtained, corrected to inside circumference and then mean diameter for each strake is obtained. Direct measurement of diameter is not regarded as sufficiently accurate. Allowance is made for rivet heads if seams are riveted, due note taken of overlaps and, of course, lower strakes are usually thicker than the upper strakes. Allowances may be necessary to take care of local deformations, fittings or manhole, etc. A typical calibration chart of a land storage tank is attached.

We have made calculations to ascertain what allowance should be made for expansion of the steel tank by rise of temperature and expansion due to the loading. For instance, for a cylindrical tank 25 ft. mean diameter, 29 ft. 7$\frac{1}{4}$ in. high, it was calculated there was an increase of about one gallon per foot of loading for a 40° F. increase in temperature of the steel, and about one gallon extra per foot for deflection under load. A total of 60 Imperial gallons in a total of 90,404 Imperial gallons equivalent to a difference in sounding or ullage of about $\frac{3}{16}$ in. Preferably, therefore, the strapping should be done when the tank is full and at the loading temperature.

WESTERN CHEMICAL INDUSTRIES LTD.

FISH OIL TANK No. 1

Vancouver, B.C.



CONTENTS ULLAGE
U. S. GALLONS

FEET	GALLONS	GALLONS	FEET
22'-7½"	17670	—	—
22'-0"	17184	486	0'-7½"
21'-0"	16407	1263	1'-7½"
20'-0"	15630	2040	2'-7½"
19'-0"	14853	2817	3'-7½"
18'-0"	14076	3594	4'-7½"
17'-0"	13299	4371	5'-7½"
16'-0"	12522	5148	6'-7½"
15'-0"	11745	5925	7'-7½"
14'-0"	10968	6702	8'-7½"
13'-0"	10191	7479	9'-7½"
12'-0"	9414	8256	10'-7½"
11'-0"	8637	9033	11'-7½"
10'-0"	7860	9810	12'-7½"
9'-0"	7083	10587	13'-7½"
8'-0"	6307	11363	14'-7½"
7'-0"	5530	12140	15'-7½"
6'-0"	4753	12917	16'-7½"
5'-0"	3976	13694	17'-7½"
4'-0"	3199	14471	18'-7½"
3'-0"	2422	15248	19'-7½"
2'-0"	1643	16027	20'-7½"
1'-0"	860	16810	21'-7½"
0	87	17583	22'-7½"

BOTTOM 12"

INCHES	U.S. GALLS.
12	860
11	794
10	728
9	663
8	607
7	542
6	477
5	412
4	347
3	282
2	217
1	152
0	87

NOTE. DISPLACEMENT OF HEATING COILS AND SUPPORTS, 9 U.S. GALLONS, INCLUDED IN ABOVE.

ELSEWHERE

	U.S. GALS.
1 FOOT	777.00
1"	64.75
½"	32.37
¼"	16.19
⅛"	8.09

Mr. C. K. STEVENSON (Bombay)

Mr. Kilgour has set forth clearly the various methods of estimating the quantity of oil in ships' deep tanks, a survey which can cause more headaches and be more time consuming than many inspections of a more technical nature.

With regard to the remarks on the uses of the quantity certificate, the Shipper, in many cases, asks, through the owners' agents, for this to be issued before bank closing time on the day of the survey in order to withdraw his money as soon as possible. It is then that the value of determining beforehand, that all necessary data is available, is proved.

In most cases, when the ship's deep tank is being prepared for the carriage of edible oil the sounding pipe is blanked off to save cleaning, and in many cases the air pipes are fitted with rust traps. Unless one has taken due precautions, as described by the Author, the final calculation may be more of a guess than an estimate, and the 2 per cent limit of adjustment exceeded, when future painful correspondence may result.

There are many deep tanks which have small screwed plugs at all four corners of the lid. It is the Writer's opinion that, for reference in these cases, the ullages as taken at the corners of the tank lid be noted on the certificate in preference to the ullages taken at the four sides of the relatively small manhole. The ullage at the manhole could also be noted. Would the Author give his opinion on the merits of using the mean of the ullages at lid corners for calculation purposes, it being assumed that the tank lid is not noticeably distorted? Apart from considerations of accuracy in the final result, is it not better to have widely spaced points of reference, bearing in mind that the ship will probably be in a different condition of trim and the oil at a different temperature giving a different ullage at the port of discharge?

Very few ships have deep tanks the lids of which are fitted with an ullage port. There are, however, a few that, not only have an ullage port, but also a properly calibrated ullage stick. When this is the case I feel that the tools supplied should be used whether calibrated from the top of the port or the bottom of the lid, and a suitable note made in the certificate. At the port of discharge, it is easier to check on an ullage taken from the top face of the ullage port. Perhaps the Author would care to comment on his preference for taking the ullages from the underside of the tank when specially designed ports are incorporated.

Mention of taking the heating coils into consideration is made. As many Liberty type ships, which carry vegetable oils in the forward deep tanks, have had the coils removed and never replaced, can the Author say whether these are included in the calibration scales and approximately how much space they take up?

Mr. J. WHITEHEAD (Lagos)

In commencing I should like to congratulate Mr. Kilgour on the interesting and comprehensive way in which he has dealt with his subject and can surmise that Surveyors abroad, faced with the prospect of carrying out their first Edible Oil Quantity Survey, need have no qualms when tackling such a task now that they are forewarned against the pitfalls. In this port Surveyors have only been called upon to verify the ullages of ship's tanks on completion of loading cargoes of palm oil and proceedings follow closely with those that have been described. There is, however, one suggestion I should like to advance, which is thought conducive towards eliminating some of the difficulties which occur in surveys of this nature, and that is, if the Shippers could be prevailed upon to provide a form of flow meter to register the quantity of oil pumped on board the ship it would at least substantiate the figures arrived at from taking ullages. It is considered that a type of combined pump and flow meter of the well-known variety found at bunkering ports could be adapted, and, in order to prevent any dispute arising over the accuracy of the instrument, suitable tests should not be too difficult to arrange. The Author's views on this suggestion are awaited with interest.

In conclusion I should like to refer the Author to some of the ingenious forms of inclinometers which are to be found occasionally in Chief Engineers' rooms whose accuracy, of course, is indisputable!

AUTHOR'S REPLY

Before replying to the discussion, I would like to mention that, in the paper I have tried to illustrate an average case that could crop up, often the Surveyor will not be required to go to the lengths described, sometimes he will be required to go to greater.

In the final paragraph on page 2 the inaccuracy produced by sounding from deck level should read $\frac{1}{4}$ in. and not $\frac{3}{4}$ in. as shown although I would not discount the possibility of getting an error as large as this. On page 4 the distance of the centre of area of the liquid surface to the ullage port is mentioned. The position of the centre of area of the free surface I find by drawing the area to scale on paper and balancing on a razor edge, this eliminates what can be a tedious calculation.

To Mr. J. Wormald

I would particularly like to thank Mr. Wormald for opening the discussion and agree with him that the purpose of any paper is to provoke discussion. A Surveyor is not able to follow hard and fast rules and therefore each person will have his own opinion of a particular method of working and the only way that we have of sorting things out is by talking about them.

Far from leaving too few loopholes for discussion I find that I have left too many and that there are quite a number of important points that have escaped my attention and which Mr. Wormald has been good enough to raise.

In so far as shore lines are concerned, it would admittedly be difficult to examine these prior to the loading of every cargo, but if oil is being regularly loaded at the port the Surveyor should be in a position to know if the tanks and pipelines have been used for any other type of oil. I am of the opinion that there is little opportunity presented for contamination from rancid oil whilst passing through the pipeline, bearing in mind of course that the storage tanks where the oil might lay for a considerable time are clean.

At Madras it was the usual practice to clean the storage tanks in a similar manner to the ships' tanks and prior to loading, the Society's Surveyor was asked to see that they were satisfactory, and a note to this effect was included in the certificate of quantity from shore tanks. Naturally, if the tanks were not cleaned this statement would be omitted, but where requested in writing to do so and when the tanks are satisfactorily cleaned I feel that more good than harm can accrue to the Society by the Surveyor rendering this very elementary service.

With regard to the taking of ullages I would say that I prefer a sinker every time on a sounding tape as this keeps the tape taut. I do not consider it unduly optimistic to obtain corrected ullages to within $\pm\frac{1}{8}$ in of the true ullage, it depends to a great degree on the Surveyor and the amount of care which he is prepared to take in the preparation of his data. Admittedly 0·16 tons of oil is little enough to worry about, but then again if we are to discard all the $\frac{1}{8}$ in. that we come across, where are we going to draw the line? The Shipper appreciates that we are working against difficulties but nevertheless expects the Lloyd's Register Surveyor to try to assess the quantity shipped honestly and without bias and our reputation for impartiality might well be damaged by an attitude that could be interpreted by interested bodies as "couldn't care less".

As far as ships' tanks are concerned it is imperative that the Society should be absolved from any discrepancy by the inclusion of a statement to the effect that the calculation was made from the "ship's calibration scales" the accuracy of which the Society cannot be responsible for.

With regard to the ullages at the manhole as shown in Appendix B I would say that this is merely an illustration and does not refer to any particular ship and the figures were merely meant to represent a ship sitting by the stern.

I have often used only one reading as suggested by Mr. Wormald, but always prefer to use the underside of the tank lid as a datum, as this fits in with the dimension "h3" previously taken as shown in Fig. 1. Where ullages are taken from is largely a matter of choice but "h3" should always be obtained, for it must be borne in mind that the jointing material used to seal the tank lid can frequently have a marked effect on this dimension with the possibility of adding to an accumulation of error.

I wish to thank Mr. Wormald for suggesting that the value of the survey would be enhanced by reliable data to work from, and I agree with him that the provision of this data could well be encouraged by the Society.

To Mr. J. Guthrie

I would like to thank Mr. Guthrie for raising some interesting points. With regard to the cleaning of the pipe lines I am of the opinion that flushing with water is quite satisfactory but should they not be used for a considerable time or be used for a different type of oil it is my opinion that they should be dismantled for cleaning. Ships' pipe lines are normally dismantled every time and either burnt out or steamed. This is necessary because of the danger of contamination from a previous cargo of a different nature such as mineral oil, which of course is toxic.

In connection with battered and encrusted drums I would like to say that I am filled with wonder at the apparent disregard of the Shipper for his cargo and with even more wonder at the fact that contamination does not occur. At least I have never heard of any complaints regarding this, but perhaps more information could be obtained in Europe regarding the number of contaminated cargoes received. I do not believe that there is any method of cleaning a battered drum nor do I believe that the Shippers are greatly concerned whether any attempt is made to clean them or not. One thing is certain, and that is that after being stored empty under a tropical sun they must have "whiskers" inside.

The specific gravities of oils of similar types can vary quite considerably, being dependent to a great degree on the quality of the seed and the area that it is grown in. I am of the opinion that it is better for the specific gravity to be determined in a laboratory, but in view of the fact that the Certificates are usually required "yesterday" so to speak, it is often more convenient for the Surveyor to take it himself. The empirical formula for determination of S.G. from saponification and iodine values should be used with great care and has only been included as a matter of general interest.

To Mr. J. R. P. Conolly

Mr. Conolly's remarks regarding open troughs are quite correct. For some reason or other the ships loading edible oils are usually loading ore at the same time and the quantity of dust in the air is considerable and no doubt gets into the troughs. But this I can assure you is the lesser of the evils for as any colleagues in Calcutta and Bombay will bear out, the coolie labour is particularly partial to oil baths and it is not uncommon to see the stevedores washing their feet in the oil destined for the very tanks over which the Surveyor has spent so much time and trouble. However, rest assured that the oil is once again purified before it reaches our tables (I hope)!

I agree that it would not be in the best interest of the owners for a ship to be delayed whilst the oil in the tank settled. My practice is to note the

time and word the certificate to the effect that in my opinion insufficient time was available for settlement.

To Mr. H. Nutter

Mr. Nutter and I have often discussed subjects from motors to mosquitoes during the long tropical evenings and therefore I was particularly happy to read his contribution. I am grateful to him for pointing out that the W.L. length at a particular trim can be quite different from the length between draught marks ; it is obviously this length that is required. His mention of difficulty in equating calibrated soundings with ullages recalls to my mind the case of a new ship where it was found that the sounding scale of the tank was approximately 3 ft. longer than the actual full sounding and it was later found that the builders had based their scales on a thermometer pipe running down the ship's side instead of at the vertical sounding pipe, as in the case of other tanks on board.

To Mr. R. Rennie

Mr. Rennie's extremely interesting and lucid account of fish oil surveys gives us a clear picture of the methods adopted on the other side of the Atlantic. I was particularly interested in the fact that estimates for residue were based on $\frac{1}{8}$ in. thickness on sides and bottom. Mr. Rennie relates an investigation carried out on the amount of air held in suspension in fish oil and as this is a question in which I am particularly interested I am led to wonder whether the oil was pumped to the tank via a pipeline connected thereto, or through a flexible hose led into a manhole at the top of the tank as would be the case in Asia.

The description of the method used for the calibration of storage tanks was of great interest and has made me wish that we could hear more about this unusual subject.

To Mr. C. L. Stevenson

Mr. Stevenson raises the question of deep tanks which have screwed plugs at all four corners of the lid. I am in agreement with him that ullages should be taken at these points and noted on the certificate, in which case it should not be necessary to take ullages at the manhole, as one of the ullage points can well be used as a reference point for the estimation. There is no objection at all to using the mean of the ullages for calculation purposes, as long as one is aware of the various heights to tank lid from the D.B. tank top, since the packing of the lid may be thicker at one side than at another.

I agree with Mr. Stevenson again on the advantage of using the ship's tools (providing they are reliable) and there can be no objection to using the top of the port, as long as the reference point is recorded on the certificate. The point that I was trying to make in the paper was the need for being aware of the fact that a tank might be calibrated from the top of the port, prior to the tank being filled.

To Mr. J. Whitehead

The practice followed in other ports of the world has given me much interest and I was interested to learn that at Lagos only the verification of the ullages on board are called for.

I am in agreement with Mr. Whitehead that it would be of great advantage to the Shipper if a flow meter of some kind could be provided to register the quantity of oil pumped aboard. Nearly all these instruments are very reliable, but there is always a small error involved and it would seem that the persons responsible for the shipment do not consider that the outlay involved would justify the result obtained.

I am not sure of the cost of these instruments, but it would appear to me that the local Chambers of Commerce in conjunction with the Port Authorities should be in a position to supply them. A thought to be borne in mind is the cleaning involved after use, which in a backward area might be delegated to a comparatively unskilled person, and in the case of drying and semi-drying oils, the danger of the instrument being ruined by improper attention.

Printed by Lloyd's Register of Shipping
at Garrett House
Manor Royal, Crawley, Sussex, England